

### APPLICATION FOR MATERIAL LICENSE

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW.

**FEDERAL AGENCIES FILE APPLICATIONS WITH:**

U.S. NUCLEAR REGULATORY COMMISSION  
DIVISION OF FUEL CYCLE AND MATERIAL SAFETY, NMSS  
WASHINGTON, DC 20555

**ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS, IF YOU ARE LOCATED IN:**

CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, MAINE, MARYLAND, MASSACHUSETTS, NEW JERSEY, NEW YORK, PENNSYLVANIA, RHODE ISLAND, OR VERMONT, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION I  
NUCLEAR MATERIAL SECTION B  
631 PARK AVENUE  
RING OF PRUSSIA, PA 19406

ALABAMA, FLORIDA, GEORGIA, KENTUCKY, MISSISSIPPI, NORTH CAROLINA, PUERTO RICO, SOUTH CAROLINA, TENNESSEE, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION II  
MATERIAL RADIATION PROTECTION SECTION  
101 MARIETTA STREET, SUITE 2900  
ATLANTA, GA 30323

**IF YOU ARE LOCATED IN:**

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION III  
MATERIALS LICENSING SECTION  
795 ROOSEVELT ROAD  
GLEN ELLYN, IL 60137

ARKANSAS, COLORADO, IDAHO, KANSAS, LOUISIANA, MONTANA, NEBRASKA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, SOUTH DAKOTA, TEXAS, UTAH, OR WYOMING, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION IV  
MATERIAL RADIATION PROTECTION SECTION  
611 RYAN PLAZA DRIVE, SUITE 1000  
ARLINGTON, TX 76011

ALASKA, ARIZONA, CALIFORNIA, HAWAII, NEVADA, OREGON, WASHINGTON, AND U.S. TERRITORIES AND POSSESSIONS IN THE PACIFIC, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION V  
MATERIAL RADIATION PROTECTION SECTION  
1450 MARIA LANE, SUITE 210  
WALNUT CREEK, CA 94596

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S. NUCLEAR REGULATORY COMMISSION JURISDICTION.

<p>1. THIS IS AN APPLICATION FOR (Check appropriate item.)</p> <p><input checked="" type="checkbox"/> A. NEW LICENSE</p> <p><input type="checkbox"/> B. AMENDMENT TO LICENSE NUMBER _____</p> <p><input type="checkbox"/> C. RENEWAL OF LICENSE NUMBER _____</p>	<p>2. NAME AND MAILING ADDRESS OF APPLICANT (Include Zip Code)</p> <p>Centerior Service Company Nondestructive Examination Section (mail stop TS-17) c/o Perry Nuclear Power Plant 10 Center Road Perry, Ohio 44081</p>
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3. ADDRESS(ES) WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED:

Centerior Service Company  
Nondestructive Examination Section (mail stop TS-17)  
c/o Perry Nuclear Power Plant  
10 Center Road  
Perry, Ohio 44081

and at temporary job locations throughout the United States

<p>4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION</p> <p>Hudson Walls, Jr.</p>	<p>TELEPHONE NUMBER</p> <p>(216) 259-3737 Ext. 6255</p>
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SUBMIT ITEMS 5 THROUGH 11 ON 8 1/2 x 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

<p>5. RADIOACTIVE MATERIAL See Attachment #1 a. Element and mass number, b. chemical and/or physical form, and c. maximum amount which will be possessed at any one time.</p>	<p>6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED. Performance of Industrial Radiography</p>
<p>7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE See Enclosure #1</p>	<p>8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS. See Enclosure #1</p>
<p>9. FACILITIES AND EQUIPMENT. N/A</p>	<p>10. RADIATION SAFETY PROGRAM See Enclosure #1</p>
<p>11. WASTE MANAGEMENT. Return to Supplier</p>	<p>12. LICENSEE FEES (See 10 CFR 170 and Section 170.31) FEE CATEGORY AMOUNT ENCLOSED \$</p>

13. CERTIFICATION: (Must be completed by applicant) THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT. THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35, AND 40 AND THAT ALL INFORMATION CONTAINED HEREIN, IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF. WARNING: 18 U.S.C. SECTION 1001, ACT OF JUNE 25, 1948, 62 STAT. 749 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

<p>SIGNATURE - CERTIFYING OFFICER</p>	<p>TYPED/PRINTED NAME</p> <p>Hudson Walls, Jr.</p>	<p>TITLE</p> <p>Manager, CSC NDE Section</p>	<p>DATE</p> <p>6/1/89</p>
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<p>14. ANNUAL RECEIPTS</p> <table border="1"> <tr> <td>&lt; \$250K</td> <td>\$1M - 3.5M</td> </tr> <tr> <td>\$250K - 500K</td> <td>\$3.5M - 7M</td> </tr> <tr> <td>\$500K - 750K</td> <td>\$7M - 10M</td> </tr> <tr> <td>\$750K - 1M</td> <td>&gt; \$10M</td> </tr> </table>		< \$250K	\$1M - 3.5M	\$250K - 500K	\$3.5M - 7M	\$500K - 750K	\$7M - 10M	\$750K - 1M	> \$10M	<p>b. NUMBER OF EMPLOYEES (Total for entire facility excluding outside contractors)</p>	<p>c. WOULD YOU BE WILLING TO FURNISH COST INFORMATION (Dollar and/or staff hours) ON THE ECONOMIC IMPACT OF CURRENT NRC REGULATIONS OR ANY FUTURE PROPOSED NRC REGULATIONS THAT MAY AFFECT YOU? (NRC regulations permit it to protect confidential commercial or financial--proprietary--information furnished to the agency in confidence)</p> <p><input type="checkbox"/> YES <input type="checkbox"/> NO</p>
< \$250K	\$1M - 3.5M										
\$250K - 500K	\$3.5M - 7M										
\$500K - 750K	\$7M - 10M										
\$750K - 1M	> \$10M										

<p>FOR NRC USE ONLY</p>				<p>RECEIVED</p>
<p>TYPE OF FEE</p> <p>app</p>	<p>DATE LOG</p> <p>June 3</p>	<p>FEE CATEGORY</p> <p>30</p>	<p>COMMENTS</p>	<p>APPROVED BY</p> <p>CP</p>
<p>AMOUNT RECEIVED</p> <p>\$100</p>	<p>CHECK NUMBER</p> <p>006506</p>	<p>DATE</p> <p>6/1/89</p>		

## PRIVACY ACT STATEMENT

Pursuant to 5 U.S.C. 552a(e)(3), enacted into law by section 3 of the Privacy Act of 1974 (Public Law 93-579), the following statement is furnished to individuals who supply information to the Nuclear Regulatory Commission on NRC Form 313. This information is maintained in a system of records designated as NRC-3 and described at 40 Federal Register 45334 (October 1, 1975).

1. **AUTHORITY:** Sections 81 and 161(b) of the Atomic Energy Act of 1954, as amended (42 U.S.C. 2111 and 2201(b)).
2. **PRINCIPAL PURPOSE(S):** The information is evaluated by the NRC staff pursuant to the criteria set forth in 10 CFR Parts 30, 32, 33, 34, 35 and 40 to determine whether the application meets the requirements of the Atomic Energy Act of 1954, as amended, and the Commission's regulations, for the issuance of a radioactive material license or amendment thereof.
3. **ROUTINE USES:** The information may be (a) provided to State health departments for their information and use; and (b) provided to Federal, State, and local health officials and other persons in the event of incident or exposure, for their information, investigation, and protection of the public health and safety. The information may also be disclosed to appropriate Federal, State, and local agencies in the event that the information indicates a violation or potential violation of law and in the course of an administrative or judicial proceeding. In addition, this information may be transferred to an appropriate Federal, State, or local agency to the extent relevant and necessary for an NRC decision or to an appropriate Federal agency to the extent relevant and necessary for that agency's decision about you.
4. **WHETHER DISCLOSURE IS MANDATORY OR VOLUNTARY AND EFFECT ON INDIVIDUAL OF NOT PROVIDING INFORMATION:** Disclosure of the requested information is voluntary. If the requested information is not furnished, however, the application for radioactive material license, or amendment thereof, will not be processed. A request that information be held from public inspection must be in accordance with the provisions of 10 CFR 2.790. Withholding from public inspection shall not affect the right, if any, of persons properly and directly concerned need to inspect the document.
5. **SYSTEM MANAGER(S) AND ADDRESS:** U.S. Nuclear Regulatory Commission  
Director, Division of Fuel Cycle and Material Safety  
Office of Nuclear Material Safety and Safeguards  
Washington, D.C. 20555





6200 Oak Tree Boulevard  
Independence OH  
216-447-3100

Mail Address:  
P.O. Box 94661  
Cleveland, OH 44101-4661

U.S. Nuclear Regulatory Commission, Region III  
Materials Licensing Section  
700 Roosevelt Road  
Glen Ellyn, Il. 60137

Attention: Director

Subject: Application for Material License

Dear Sirs,

Please find herewithin enclosed 2 copies of completed Form 313, attachments and enclosures, submitted by the Centerior Service Company in consideration as a "New License".

Additionally please find enclosed the license application fee in the amount of \$700.00 in the form of check #C00650F

To assist in the evaluation of this application the following outlines applicable NRC Form 313 Item numbers and associated attachments or enclosures:

- Item #5            See Attachment #1
- Item #6            For Performance of Industrial Radiography
- Item #7            See Enclosure #1 (Section 4.0), #2 (H. Walls Jr. resume),
- Item #8            See Enclosure #1 (Section 5.0)
- Item #9            N/A-Field Radiography Only
- Item #10           See Enclosure #1 (complete)
- Item #11           Return to Suppliers Listed in Attachment #1 for Disposal

RECEIVED  
JUN 02 1989  
REGION III

CONTROL NO. 87458

JUN 2 1989

The following additional statements are intended to govern CSC's Industrial Radiographic Operations under this license:

1. CSC herein requests license approval for the possession of up to 2000 Kg. of Depleted Uranium 238 to be used as shielding in radiographic exposure devices and source changer's listed on Attachment #1.
2. Radiographic exposure devices and/or source changers in storage at temporary jobsites shall be secured and locked in accordance with Enclosure #1 (Section's 11.0, 12.0, and 14.0).

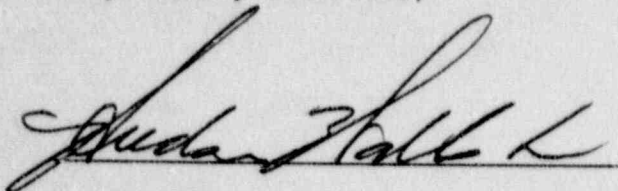
The equipment shall be kept locked and shall be physically secured to prevent access or removal by unauthorized personnel. Access to storage areas shall be kept locked and shall be posted in accordance with 10 CFR Part 20, subpart 20.203 (e) (1) (See Attachment #2, Source Storage Area Sketch).

3. Record retention shall be at the location identified on NRC Form 313, Item #2.

Your most expedient consideration of the enclosed application would be greatly appreciated.

If any additional information is required or if you should have any questions, please feel free to contact me at the address listed below or phone 216-259-3737 ext. 6255.

Respectfully submitted,



Hudson Walls Jr.  
Industrial Radiography, Radiation Safety Officer

Centerior Service Company  
Nondestructive Examination Section  
Mail Stop TS-17  
c/o Perry Nuclear Power Plant  
10 Center Road  
Perry, Ohio 44081

CONTROL NO. 87458

ATTACHMENT #1 - For NRC Form 313, Item #5

Radioactive Material  
Element & Mass No.

Chemical or  
Physical Form

Maximum Activity

Manufacturer & Model  
No. (Exposure Devices)

Manufacturer & Model  
No. (Source Changers)

Iridium 192

Amersham Corp.  
Model 424-9  
Sealed Source  
or  
Source Production  
and Equipment Co.  
(SPEC) Model T-5  
Sealed Source

No single source  
to exceed 100  
curies

Amersham Corp.  
Model 660

Amersham Corp.  
Models: 650, C-10  
U-110, 500SU.  
or  
Source Production  
and Equipment Co.  
(SPEC) Model C-1

CONTROL NO. 87458



(Enclosure #2 to Application for Material License)

**R E S U M E**

**TRAINING AND EXPERIENCE IN  
RADIOGRAPHY AND RADIATION SAFETY**

**Hudson Walls, Jr.**

**TECHNICAL TRAINING**

**September, 1965  
US Navy**

Successfully completed a fourteen (14) week course in Nondestructive Testing of Metals presented by the U. S. Navy. The course included instruction in Radiation Physics, Health Physics and other nondestructive testing methods.

**1967 - US Navy**

Attended a two (2) week advance radiography course at the Army Materials Research Center in Watertown, Massachusetts.

**1976 - C.E.I.**

Attended an indoctrination program for radiation safety and general health physics as it relates to Operating Nuclear Power Plants.

**1988 - C.E.I.**

Attended a week long course in Radiation Safety and Equipment. Successfully passed a written exam at the end of these studies.

**EXPERIENCE**

**November, 1965 -  
1967 - US Navy**

Assigned to the Hull Repair Division where duties were to assist in the design and building of the first ship board NDT lab in the Cruiser/Destroyer fleet.

**1967 - 1970  
US Navy**

Advanced to Chief Petty Officer with duties as stated above and including supervision of NDE personnel.

1970 - 1973  
US Navy  
USS Puget Sound

Primary Duty was NDT shop supervisor. Collateral duties consisted of Radiographic Safety Officer for the Cruiser Destroyer Force, Atlantic fleet. These duties included training and examining of NDT personnel throughout the Atlantic Fleet, auditing the other NDT Units for Radiation Safety, writing the approved revision of the Operating and Emergency Procedures and Training, and indoctrination of personnel.

September, 1973  
US Navy

Performed duties of NDT supervisor at the submarine base in New London, Connecticut.

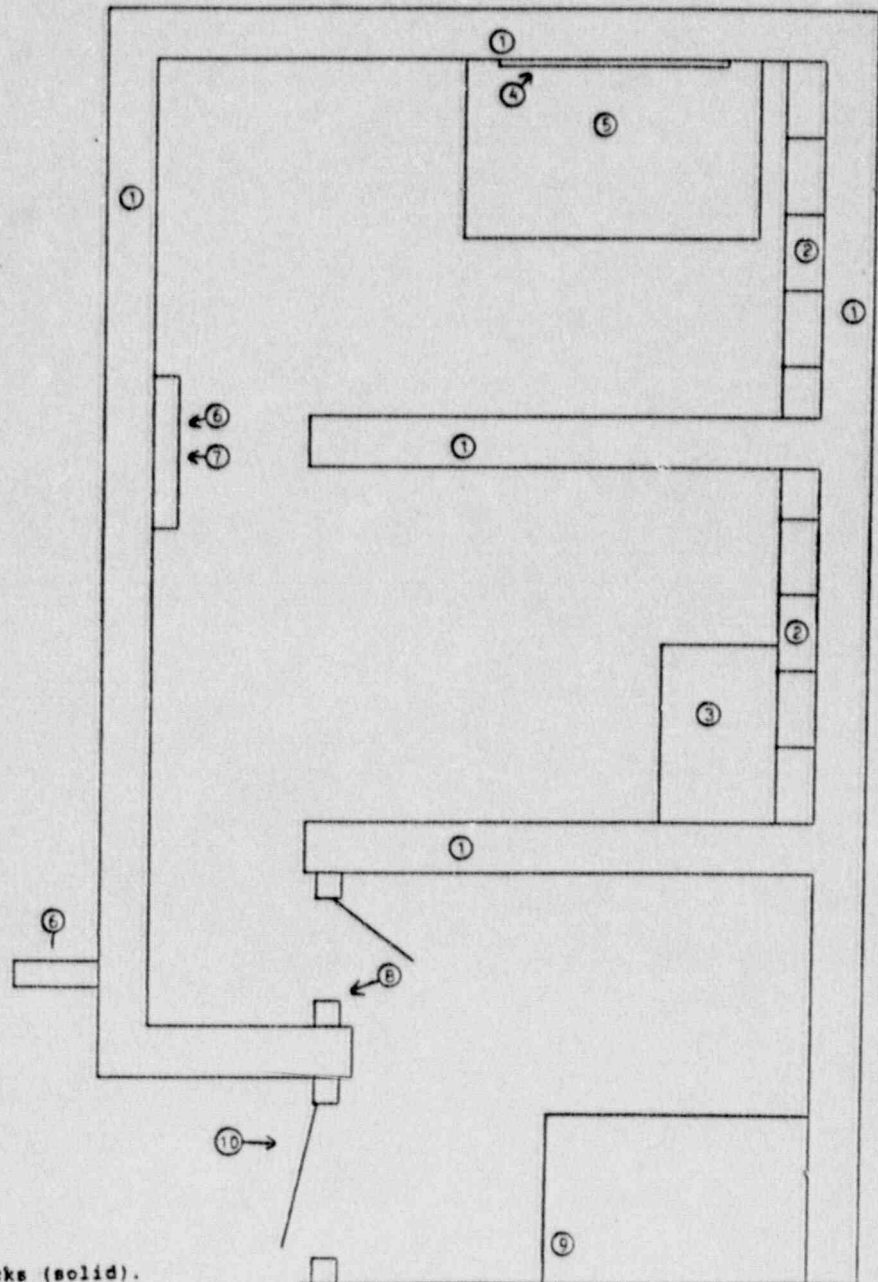
January, 1974 -  
March, 1976  
US Navy

Assistant Quality Assurance Officer. Responsible for overseeing of all facets of NDT activities including Radiation Safety and Monitoring Programs.

**CENTERIOR SERVICE COMPANY  
NONDESTRUCTIVE EXAMINATION SECTION  
X-RAY SHOOTING VAULT & (PROPOSED) RADIOGRAPHIC SOURCE STORAGE AREA**

Located At  
Perry Nuclear Power Plant - Unit #2  
Turbine Building (624') - Hydrogen Analyzer Room

(Attachment #2)



1. 12" thick concrete walls.
2. 8"x8"x12" stacked concrete blocks (solid).
3. Proposed radiographic source storage cabinet.
4. 1/4" lead sheeting.
5. X-Ray exposure table & 300KV X-Ray unit.
6. X-Ray ON warning lights (2).
7. Emergency X-Ray Off switch.
8. X-Ray door interlock switch.
9. X-Ray control unit.
10. X-Ray exposure room entrance (lockable).

Note: This room is used for shielded room radiography, X-Ray only. If gamma radiography is to be performed, it will be handled as a field exposure.

CONTROL NO. 87450



(ENCLOSURE #1)

CSC INDUSTRIAL RADIOGRAPHY PROGRAM

CONTROL NO 87458

# CENTERIOR SERVICE COMPANY

## NONDESTRUCTIVE EXAMINATION SECTION

### INDUSTRIAL RADIOGRAPHY PROGRAM

Prepared by: R. L. Portmann *RLP* 6 / 1 / 89  
Endorsed by: D. B. Amerine *DBA* 6 / 1 / 89  
Approved by: H. Walls, Jr. *HW* 6 / 1 / 89

CONTROL NO: N/A

ASSIGNED TO: N R C

## 1.0 - TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Rev.</u>	<u>Date</u>
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3	Statement of Policy	0	12/15/88
4	Responsibilities/Organization	0	12/15/88
5	Training and Qualifications	0	12/15/88
6	Performance Reviews and Audits	0	12/15/88
7	QA Program for Transportation	0	12/15/88
8	Receipt and Shipping of Radioactive Material	0	12/15/88
9	10CFR21 Requirements	0	12/15/88
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11	Radiation Surveys and Postings	0	12/15/88
12	Operating, Locking and Securing Sources	0	12/15/88
13	Quarterly Inventory and Maintenance	0	12/15/88
14	Transportation of Sources	0	12/15/88
15	Leak Tests	0	12/15/88
16	Source Changes	0	12/15/88
17	Emergency Instructions	0	12/15/88
18	Abbreviations and Definitions	0	12/15/88
19	Forms	0	12/15/88

<u>App.</u>	<u>Title</u>
A	Applicable Federal Regulations (10CFR Parts 19,20,21,34 and 71)
B	Radiation Incidents
C	Material License

NOTE: Information contained in the Appendices may periodically be updated. Updating of this information does not constitute a revision to the program or require a License change.



**CSC NDE Section**  
**Industrial Radiography Program**

**Section: 2.0**  
**Title: Introduction**  
**Page 1 of 1**  
**Revision 0**

## **2.0 INTRODUCTION**

**2.1 This Industrial Radiography Program Manual contains specific instructions that must be adhered to in order to comply with all applicable federal regulations that govern industrial radiography.**

**2.2 Each manual will be controlled by a number, identifiable to a recipient. It is the responsibility of all manual holders for maintenance and upkeep of the manual. Any changes made within a section will constitute a revision for that entire section (see note). The affected paragraph(s) will be highlighted with a line in the margin. Revisions will be issued by means of a transmittal which is required to be signed, dated and returned to the sender.**

**NOTE: Phone numbers, mail stops or addresses of individuals identified within this program or information contained in the appendices may periodically be updated. Updating of this information does not constitute a revision to that section or a license change. However, this updated information shall be controlled by means of a transmittal.**

**2.3 All personnel who perform industrial radiography are required to become familiar with the contents of this manual in order to maintain a safe Industrial Radiography Program.**

**CSC NDE Section**  
**Industrial Radiography Program**

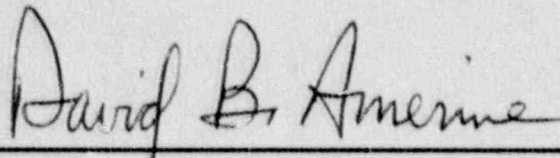
Section: 3.0  
Title: Statement of Policy  
Page 1 of 1  
Revision 0

**3.0 STATEMENT OF POLICY**

**It is the policy of Centerior Service Company to establish, maintain and implement an Industrial Radiography Program that complies with the requirements of Title 10 Code of Federal Regulations Parts 19, 20, 21, 34 and 71.**

**This program describes in detail the specific responsibilities, duties and authority of all personnel performing radiography. The Radiation Safety Officer is hereby given the authority and responsibility for implementation and maintenance of this program. Each person involved with this program is responsible for compliance with its contents.**

**This program has the unconditional endorsement of Management at Centerior Service Company.**



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**David B. Amerine - Director**  
**Nuclear Services Department**  
**Centerior Service Company**

**CSC NDE Section**  
**Industrial Radiography Program**

Section: 4.0  
Title: Organization/Responsibilities  
Page 1 of 3  
Revision 0

## **4.0 ORGANIZATION/RESPONSIBILITIES**

### **4.1 RADIATION SAFETY OFFICER (RSO)**

The Radiation Safety Officer is assigned the duties of maintaining active control of the Industrial Radiography Program. This individual should be a qualified Radiographer with training in the use of radiographic equipment utilized by CSC and familiar with all federal regulations that govern their use.

#### **1. RSO Responsibilities:**

- \* Serve as CSC liaison officer with the NRC on industrial radiography licensing matters;
- \* Maintaining Control of procurement and disposal of industrial radiography licensed material;
- \* Develop and maintain up-to-date operating and emergency instructions;
- \* Establish the training program for Radiographer's and Radiographer's Assistants;
- \* Establish radioactive material storage facilities;
- \* Establish the Leak Testing Program;
- \* Establish the Audit Program;
- \* Establish source replacement and source labeling instructions;
- \* Ensure radiation survey instruments are calibrated in accordance with approved procedures;
- \* Establish a personnel radiation monitoring program;
- \* Ensure that records are maintained in accordance with Federal regulations;
- \* Assuming control and instituting corrective action in emergency situations;
- \* Investigating the cause of incidents and determining necessary preventive action

### **4.2 ASSISTANT RADIATION SAFETY OFFICER (ASST. RSO)**

The Assistant Radiation Safety Officer is assigned the duties of assisting the RSO in maintaining the Industrial Radiography Program. This individual should be a qualified Radiographer with training in the use of radiographic equipment utilized by CSC and familiar with all Federal regulations that govern their use.

#### **1. Asst. RSO Responsibilities:**

- \* Maintain personnel monitoring;
- \* Ensure radiation survey instruments are calibrated;
- \* Conduct training for Radiographers and Radiographers' Assistants;



# CSC NDE Section

## Industrial Radiography Program

Section: 4.0

Title: Organization/Responsibilities

Page 2 of 3

Revision 0

(ASST. RSO continued)

- **Maintain radioactive material storage facilities;**
- **Maintain exposure devices, radiographic facilities and associated equipment;**
- **Conduct quarterly inventories and maintain utilization logs;**
- **Review and assure maintenance of records;**
- **Conducting audits;**
- **Assume the RSO responsibilities in his absence.**

### 4.3 RADIOGRAPHER

The Radiographer is responsible for the safe use and control of industrial radiography sources and assigned equipment, implementing operating and emergency instructions, performing surveys and completion of records as required by this manual.

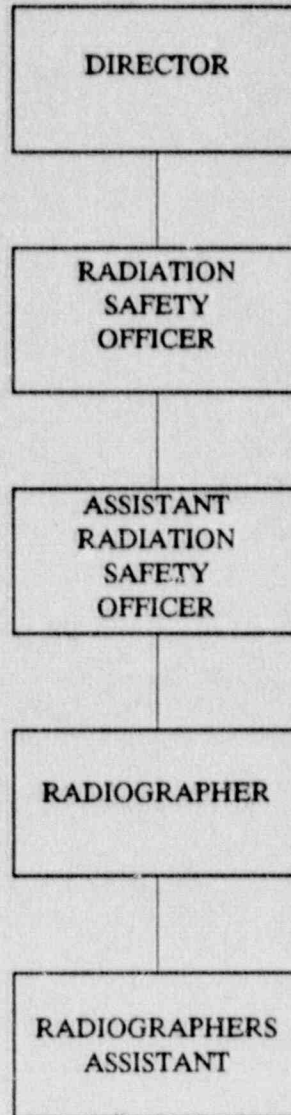
### 4.4 RADIOGRAPHER'S ASSISTANT

The Radiographer's Assistant is responsible for the safe use and control of industrial radiography sources under the direct supervision of a Radiographer, RSO or Asst. RSO, using personnel monitoring equipment and performing assigned duties as required by this manual.

**CSC NDE Section  
Industrial Radiography Program**

Section: 4.9  
Title: Organization/Responsibilities  
Page 3 of 3  
Revision 0

**CENTERIOR SERVICE COMPANY  
ORGANIZATIONAL CHART**



**CSC NDE Section**  
**Industrial Radiography Program**

Section: 5.0

Title: Personnel Training & Certification

Page 1 of 11

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## **5.0 PERSONNEL TRAINING & CERTIFICATION**

### **5.1 RESPONSIBILITIES**

- 1. The Radiation Safety Officer (RSO) is responsible for the administration of the Radiation Safety Training Program outlined in these procedures and for the examination and certification of Radiographers and Radiographer's Assistants.**

### **5.2 TRAINING**

#### **1. Assistant Radiographer**

- A. All individuals desiring certification as an Assistant Radiographer must receive a minimum of forty (40) hours of formal basic radiation instructions prior to certification.**
- B. The training may be administered by the Radiation Safety Officer, Assistant RSO or any nationally recognized training facility approved by the RSO.**

#### **C. Regardless of administration of training the following text shall be followed:**

- 1. Origin and Nature of Radiation - 4 hours**
  - a. Structure of the atom**
  - b. Periodic table of elements**
  - c. Isotopes**
  - d. Curie**
  - e. Unit of Radiation dose (rems, mrem)**
  - f. Radioactive decay and half life**
- 2. Characteristics of Gamma Rays and X-Rays - 2.5 hours**
  - a. Energy**
  - b. Wavelength**
  - c. Intensity**
  - d. Electromagnetic Spectrum**
- 3. Interaction of Radiation with Matter - 2.5 hours**
  - a. Penetration**
  - b. Absorption**
  - c. Scatter**
  - d. Ionization**



**CSC NDE Section**  
**Industrial Radiography Program**

**Section: 5.0**

**Title: Personnel Training & Certification**

**Page 2 of 11**

**Revision 0**

**(TRAINING continued)**

- e. Shielding**
- 4. Units of Radiation Dose - 2.0 hours**
  - a. Dose and dose rate**
  - b. Levels of radiation from licensed material**
  - c. REM**
- 5. Biological Effects and Hazards of Exposure to Radiation - 3.0 hours**
  - a. Effects on organs and tissues of the body.**
  - b. Nature and consequences of radiation exposure at various levels of exposure.**
- 6. Methods of Controlling Radiation Dose - 4.0 hours**
  - a. Time**
  - b. Distance**
  - c. Shielding**
  - d. Inverse Square Law**
- 7. Radiation Detection and Measurement - 4.5 hours**
  - a. Pocket dosimeters**
  - b. Film badges and thermoluminescent dosimeters**
  - c. Survey meters**
  - d. Survey techniques**
  - e. Calibration**
  - f. Operation**
  - g. Limitations**
- 8. Inspection and Maintenance of Radiography Equipment - 3.5 hours**
  - a. Exposure devices**
  - b. Remote handling equipment**
- 9. Case Histories of Radiography Accidents - 4.0 hours**
- 10. Transportation - 3.0 hours**
  - a. Regulations and requirements**
  - b. Package design**
  - c. Package labeling and identification**

**CSC NDE Section**  
**Industrial Radiography Program**

Section: 5.0

Title: Personnel Training & Certification

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(TRAINING continued)

- d. Placarding
- e. Package radiation levels

**11. Radiographic Equipment - 4.0 hours**

- a. Typical exposure devices, source changes, storage containers.
- b. Source guide tubes
- c. Remote handling equipment
- d. Shielding materials incorporated into devices
- e. Collimators
- f. Operational requirements

**12. Operating and Emergency Procedures - 3.0 hours**

- a. General requirements
- b. Purpose and use

- D. Documentation of training shall be completed on the Training Record for Radiography Personnel (attach. 9) and maintained in the employees training and certification file.
- E. Individuals may receive training from authorized training institutions and/or another licensee's approved training program (previous employer). All prior training must meet or exceed the guidelines of 5.2.1.C and must be verified.
- F. In addition to the requirements of 5.2.1.C, the following specific training shall be completed prior to examination:
  - 1. Radiographic equipment in use by CSC.
    - a. Exposure device(s), source changers, storage containers.
    - b. Source guide tubes and remote handling equipment.
    - c. Shielding materials incorporated into devices.
    - d. Collimators.
    - e. Operation of devices.
  - 2. Company Operating and Emergency Procedures.
  - 3. Regulatory Standards.

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(TRAINING continued)

4. Reporting of Non-compliances.
2. Radiographer (Prior certification as Assistant Radiographer with CSC)
  - A. An individual is eligible for radiographer certification after 520 documented hours as an Assistant Radiographer and successful completion of the radiographers examination.
3. Radiographer (Prior training as a radiographer with another licensee)
  - A. An individual that was previously trained and certified as a Radiographer with another licensee, may by-pass the training if the following conditions are validated.
    1. Performed radiography within the last six (6) months.
    2. Validate the training as outlined in 5.2.1.
    3. Must receive training as outlined in para. 5.2.1.F and thirty-two (32) hours of on-the-job training with CSC equipment.
4. Assistant Radiation Safety Officer
  - A. The qualification prerequisites for Assistant Radiation Safety Officer are:
    1. Possession of a high school diploma or equivalency on the GED test.
    2. Completion of training and certification as a Radiographer with the company.
    3. A minimum of two (2) years experience in industrial radiography involving isotope handling.
    4. Completion of additional training addressing:
      - a. Principles of radiation safety
      - b. Radiation safety program
      - c. Administering the radiation safety program
      - d. Conducting and evaluating examinations
      - e. Identification and handling of hazardous situations and reporting
      - f. State and Federal Regulations



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**B. The training (specific) of the Assistant Radiation Safety Officer shall be completed by the RSO.**

**5. Radiation Safety Officer**

**A. The qualification prerequisites for the RSO are:**

- 1. High school graduate or equivalency on the GED test.**
- 2. A minimum of two years experience in industrial radiography involving isotope handling.**
- 3. Completion of additional training addressing:**
  - a. Principles of radiation safety.**
  - b. Radiation safety program.**
  - c. Administering the radiation safety program.**
  - d. Conducting and evaluating examination.**
  - e. Identification and handling of hazardous situations and reporting occurrences.**
  - f. State and Federal regulations.**

**6. Annual Training**

**A. All radiographic personnel shall receive annual refresher training in the following material as applicable:**

- \* Revisions to the Industrial Radiography Program.**
- \* Revisions to applicable federal requirements.**
- \* Review of audit findings.**
- \* Review of radiation incident(s).**

**B. Records of periodic refresher training shall be documented on an Annual Training Review Form (attach. 10) and provide the following information:**

- \* Name(s) of instructor(s).**
- \* Name and social security number of trainee.**
- \* Date(s) of training.**
- \* Subject(s) discussed.**

**5.3 EXAMINATIONS**

**1. Assistant Radiographer**

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**(EXAMINATIONS continued)**

- A. Each individual, prior to certification as an Assistant Radiographer, shall be administered an examination consisting of a minimum of twenty-five (25) written questions and a practical demonstration. The examination shall be administered following completion of all required training and shall consist of the following:**
- \* General: Contain as a minimum of ten (10) questions on basic radiation safety (closed book).**
  - \* Specific: Contain a minimum of fifteen (15) questions of the Operating and Emergency Procedure (open book).**
  - \* Practical: Required to demonstrate competence concerning the use of radiographic devices, sealed sources, related handling tools and survey instruments.**
  - \* Oral review: Following examination, shall be conducted with the employee clarify any questions and correct misunderstandings.**
- B. The test will be administered and practical evaluated by a certified Radiographer, Assistant RSO or RSO.**
- C. The examination shall be developed by the RSO or his designee and the grading master shall be maintained by the RSO.**
- D. The examination shall be graded by the RSO or his designee.**
- E. An examination score of 80% or greater for each written portion and 100% for the practical demonstration shall be considered as an acceptable score.**

**2. Radiographer**

- A. Each individual, prior to certification as a Radiographer, shall be administered an examination consisting of a minimum of fifty (50) written questions and a practical demonstration.**

**The exam shall be administered following completion of all required training and shall consist of the following:**

- \* General: Contain at least twenty-five (25) written questions on basic radiation safety (closed book).**



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**(EXAMINATIONS continued)**

- **Specific: Contain at least twenty-five (25) written questions (open book) addressing the following:**
  - **Operating and Emergency procedure.**
  - **Radiographic Equipment and survey meter.**
  - **USNRC regulations as they pertain to the Industrial Radiography Program.**
- **Practical: Demonstrate competence concerning the use of radiographic devices, sealed sources, related handling equipment and survey instruments.**
- **Oral review: Following examination, shall be conducted with the employee to clarify any questions and correct misunderstandings.**

**B. The test will be administered and practical evaluated by a certified Radiographer, Assistant RSO or RSO.**

**C. The examination shall be developed by the RSO or his designee and the grading master shall be maintained by the RSO.**

**D. The examination shall be graded by the RSO or his designee.**

**E. An examination score of 80% or greater for each written portion and 100% for the practical demonstration shall be considered an acceptable score.**

**3. Assistant Radiation Safety Officer**

**A. Each individual, prior to certification as an Assistant Radiation Safety Officer, shall be administered an examination consisting of a minimum of eighty (80) written questions and a practical demonstration.**

**The examination shall be administered following completion of all required training and shall consist of the following:**

- **General: Consist of twenty-five (25) questions on basic radiation safety (closed book).**
- **Specific: Consist of a minimum of fifty-five (55) written questions (open book) addressing:**
  - a. CSC Industrial Radiography Program.**



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### (EXAMINATIONS continued)

b. USNRC regulations.

c. License.

d. Personnel training and certification practice.

- **Practical: Evaluation shall address the administration of the Industrial Radiography Program with specific emphasis on emergency procedure requirements.**
- **Oral review: Following examination shall be conducted with the employee to clarify any questions and correct misunderstandings.**

**B. The test will be administered and practical evaluated by the RSO.**

**C. The examination shall be developed by the RSO or his designee and the grading master shall be maintained by the RSO.**

**D. The examination will be graded by the RSO.**

**E. An examination score of 80% or greater for each written portion and 100% for the practical shall be considered an acceptable score.**

#### **4. Re-Training**

- A. In the event that an employee fails to satisfactorily complete any portion of the examination, the employee shall be retested after retraining. The specific retraining shall be determined by the individual conducting the exam and shall be approved by the RSO.**

### **5.4 CERTIFICATION**

#### **1. Certification Prerequisites**

**The certification prerequisites for all individuals are:**

**A. Minimum age: 18 years**

**B. No known history of previous exposure which would prohibit or cause restriction to activity.**

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- C. Free from physical handicaps which could endanger themselves or others during performance of radiography.

**2. Assistant Radiographer**

- A. Completion of the radiation safety training program.
- B. Satisfactory completion of the examination per para. 5.3.1.
- C. Determine and document the individuals previous radiation exposure. A record of previous radiation exposure shall be maintained on Form NRC-4 or the Company form which will provide the same information. Radiation exposure history documentation received from an individuals former employer(s) shall be included as part of the individuals radiation exposure history.
- D. Provide the individual with their personal copy of the license and Operating and Emergency Procedures. A signed receipt for these documents shall be maintained as part of the individuals Radiation Safety Personnel file.
- E. Certification shall remain in affect for a period of 3 years, provided the employee has actively participated in radiography during a period not to exceed 90 days. If the employee does not meet the 90 day period, he shall be re-tested as specified by the RSO.

**3. Radiographer**

- A. Previous certification as an Assistant Radiographer and completion of the Radiographer training requirements.
- B. Satisfactory completion of the examination per para. 5.3.2
- C. Determine and document the individuals previous radiation exposure. A record of previous radiation exposure shall be maintained on Form NRC-4 or the Company form which will provide the same information. Radiation exposure history documentation received from an individuals former employer(s) shall be included as part of the individuals radiation exposure history.



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- D. Provide the individual with their personal copy of the license and Operating and Emergency Procedures. A signed receipt for these documents shall be maintained as part of the individuals Radiation Safety Personnel file.**
  - E. Certification shall remain in affect for a period of 3 years, provided employee has actively participated in radiography during a period not to exceed 90 days. If the employee does not meet the 90 day period, he shall be re-tested as specified by the RSO.**
- 4. Assistant Radiation Safety Officer**
- A. Previous certification as a Radiographer with a minimum of two (2) years experience and completion of the training required.**
  - B. Satisfactory completion of the examination per para. 5.3.3.**
  - C. Determine and document the individuals previous radiation exposure. A record of previous radiation exposure shall be maintained on Form NRC-4 or the Company form which will provide the same information. Radiation exposure history documentation received from an individuals former employer(s) shall be included as part of the individuals radiation exposure history.**
  - D. Provide the individual with their personal copy of the license and Operating and Emergency Procedures. A signed receipt for these documents shall be maintained as part of the individuals Radiation Safety Personnel file.**
  - E. Years of certs not to exceed 3 years.**
- 5. Radiation Safety Officer**
- A. Previous certification as a radiographer with a minimum of 2 years experience and completion of training .**
  - B. Appointed by the Director of Nuclear Services, Centerior Energy.**



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(CERTIFICATION continued)

- C. Approved by the Nuclear Regulatory Commission.
- D. Certification shall remain in effect for 5 years unless otherwise determined by the Director.
- 6. Upon successful completion of all requirements, the RSO shall document on a Qualification Basis for radiography personnel (attach. 1), certifying those individuals.

**5.5 RECORDS**

Personnel training and certification records are to be maintained a minimum of one year after employee termination.

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## **6.0 PERFORMANCE REVIEWS AND AUDITS**

### **6.1 PERFORMANCE REVIEWS**

The RSO is responsible for ensuring that performance reviews for each Radiographer and Radiographer's Assistant are performed at intervals not to exceed three months. If a Radiographer or Radiographer's Assistant does not perform radiography for a period that exceeds 3 months, conduct the performance review the next time that person engages in radiographic operations.

1. Personnel who conduct the reviews shall be familiar with and have had prior radiographic experience. The review shall consist of the following:
  - \* Those areas necessary to assure compliance with this manual.
  - \* Applicable NRC requirements.
  - \* Observation of actual radiographic operations.
2. Each performance review shall be documented on a Performance Review Checklist (see attachment 12) that describes those areas reviewed.

### **6.2 AUDITS**

The RSO is responsible for assuring the Audits of the Industrial Radiography Program are performed at intervals not to exceed twelve months.

1. Personnel who perform audits do not necessarily have to have had prior radiographic experience. The Audit may consist of any or all area's covered within this manual.
2. Each Audit shall be documented on a checklist, approved by the RSO, that describes those areas audited.

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**6.3 CORRECTIVE ACTION**

- 1. If in the judgement of the RSO or Asst. RSO; a Radiographer or Radiographer's Assistant fails to demonstrate an adequate understanding of the requirements of this manual they shall be immediately disqualified and prohibited from performing radiographic operations until they have received additional training in those deficient areas.**
- 2. Areas of noncompliance with this manual, as discovered during Audits, shall be brought to the appropriate level of management attention for disposition. Copies of all audits as a minimum shall be distributed to the Director, Corporate Health Physicist, RSO, and Asst. RSO.**

**6.4 RECORDS**

**The following records shall be maintained for a minimum of three years:**

- \* Performance Review Checklists**
- \* Audit Checklists**
- \* Corrective action documents**



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**7.0 QUALITY ASSURANCE PROGRAM FOR  
TRANSPORTATION PACKAGING PER  
10CFR71, AS APPLICABLE TO INDUSTRIAL  
RADIOGRAPHY**

**7.1 ORGANIZATION**

The final responsibility for the Quality Assurance Program for 10CFR71 requirements rest with the CENTERIOR SERVICE Company. Design and fabrication of radioactive material shipping packages are not conducted under this Quality Assurance Program. The Quality Assurance Program is implemented using the organization specified in section 4 of CENTERIOR SERVICE Company's Industrial Radiography Program.

The Radiation Safety Officer is responsible for overall administration of the program, training and certification, document control and auditing.

**7.2 QUALITY ASSURANCE PROGRAM**

The management of the CENTERIOR SERVICE Company established and implements this Quality Assurance Program. Training for all QA functions, prior to engagement in these functions, is required according to written procedures. QA Program revisions are made according to written procedures with management approval. The QA Program emphasizes control of the characteristics of the package which are critical to safety.

The Radiation Safety Officer shall assure that all radioactive material shipping packages are designed and manufactured under a Quality Assurance Program approved by the Nuclear Regulatory Commission for all packages designed or fabricated after 1 January 1979. This requirement can be satisfied by receiving a certification to this effect from the manufacturer.

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### 7.3 DOCUMENT CONTROL

All documents related to a specific shipping package will be controlled through the use of written procedures. All document changes are performed according to written procedures approved by management.

The Radiation Safety Officer shall insure that all QA functions are conducted in accordance with the latest applicable changes to these documents.

### 7.4 HANDLING, STORAGE, AND SHIPPING

Procedures concerning the handling, storage and shipping of packages for certain special form radioactive material are provided. Shipments will not be made unless all test, certifications, acceptances, and final inspections have been completed.

Radiography personnel shall perform the critical handling, storage and shipping operations.

### 7.5 INSPECTION, TEST AND OPERATING STATUS

Inspection, test and operating status of packages for certain special form radioactive material are indicated and controlled by written procedures. Status is indicated by tags, labels, markings or log entries. Status of nonconforming parts or packages is positively maintained by written procedures.

Radiography personnel shall perform the regulatory required inspections and tests in accordance with written procedures. The Radiation Safety Officer shall ensure that these functions are performed.

### 7.6 AUDITS

Established schedules of audits of the Quality Assurance Program shall be performed using written checklists. Results of audits shall be maintained and reported to management. Audit reports shall be evaluated and deficient areas corrected. The audits are dependent on the safety significance of the activity being audited, but each activity shall be audited at least once per year. Audit reports are maintained as part of the quality assurance records. Members of the audit team shall have no responsibility in the activity being audited.

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**7.7 QUALITY ASSURANCE RECORDS**

**Records of package approvals (including references and drawings), certificates of compliances, inspections, tests, operating logs, audit results, personnel training and qualifications and records of shipments will be maintained. Descriptions of equipment and written procedures shall also be maintained.**

**The records shall be identifiable, retrievable and maintained in fireproof cabinets by the Radiation Safety Officer.**



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## **8.0 RECEIPT AND SHIPPING OF RADIOACTIVE MATERIAL**

### **8.1 RECEIPT OF RADIOACTIVE MATERIAL**

Source packages shall be monitored as soon as practicable after receipt, but no later than three hours after receipt during normal working hours, or eighteen hours if received after normal working hours.

1. Only qualified Radiographers, RSO or Asst. RSO may survey and/or open packages containing radioactive material.

**NOTE:** If the radioactive material is received at the Perry Nuclear Power Plant (License No. NPF-58) the receipt inspection surveys may be performed by qualified Radiation Protection Section, Health Physics Unit personnel in accordance with approved site procedures. A copy of their inspection report will be attached to the Radioactive Material Receipt Inspection Report (see attachment 5).

2. Upon receipt, survey the exterior surface of the package to assure that radiation levels are not in excess of 200mR per hour and at a distance of three feet to assure that radiation levels are not in excess of 10mR/hr.
  - A. If the radiation survey reveals radiation levels in excess of allowable limits, specified above, the package shall be segregated, roped off, barricaded or otherwise stored to preclude unnecessary exposure above 2mR/hr and the RSO notified immediately in accordance with the Emergency instructions contained in Section 17.
3. Ensure that the manufacturer has provided proof that a leak test of the source itself has been accomplished within the previous 6 months. Document the leak test date on the Radioactive Material Receipt Inspection Report (see attachment 5) and attach the manufacturer's documentation to the inspection report. Complete the Radioactive Material Receipt Inspection Report and forward it to the RSO.

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### (RECEIPT OF RADIOACTIVE MATERIAL continued)

**NOTE:** If a leak test has not been performed within the previous six (6) months or documentation does not exist, place the package in storage and do not utilize until the documentation can be obtained from the supplier or a leak test is performed.

## 8.2 SHIPPING OF RADIOACTIVE MATERIAL

The RSO is responsible for assuring that radioactive material is packaged and labeled in accordance with applicable federal regulations.

### 1. Preparation - General All Packages




- A. When radiographic exposure devices or source changer's are prepared for shipping, assure that the source is in the properly stored position or that the device or changer is empty. Prepare for shipment as follows:
  1. Exposure Device - ensure that the shipping plug is securely in place and the device is locked.
  2. Source Changer - ensure that the source hold down and cover are properly sealed, bolted and locked.
- B. Each package shall have the exterior surface marked or labeled in accordance with the following:
  1. Measure the radiation level at one meter (3.3 feet) from all exterior surfaces of the outer package to assure that the radiation level is less than 10mR/hr. The maximum radiation level measured one meter from any exterior surface is the Transport Index. (Example; with a maximum radiation level of 2.2mR/hr, the transport index [T.I.] is 2.2).
  2. Select the proper shipping labels according to the radiation levels at the surface and at one meter from the surface, as shown in the following table (Figure 8-1). Properly complete two shipping labels listing the radionuclide, the activity (expressed in curies) and the transport index.
  3. Remove all of the old shipping labels from the shipping container. Apply the properly completed shipping labels to two opposite sides of the container. Assure bolts are tightened and seal wires are fastened, if so equipped.

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**(SHIPPING OF RADIOACTIVE MATERIAL continued)**

**FIGURE 8-1**

	Maximum Radiation Level	
	at Surface	at One Meter
Radioactive White I 	0.5 mrem/hr	None
Radioactive Yellow II 	50 mrem/hr	1.0 mrem/hr
Radioactive Yellow III 	200 mrem/hr	10 mrem/hr

**2. Preparation - Specific**

Prepare the package for shipment in accordance with the specific package type as outlined in A, B or C below.

**A. Exposure Device/Service Changer - Uranium Shielded Container with Radioactive Material**

Properly complete the shipping papers indicating:

- \* Proper shipping name (Radioactive Material, Special Form N.O.S. UN 2974).
- \* Name of radionuclide (Iridium-192).
- \* Activity of source (in curies).
- \* Category of label applied to container (e.g. Radioactive Yellow II).
- \* Transport Index.
- \* Type B identification number.
- \* Shipper's certification stating:



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**(SHIPPING OF RADIOACTIVE MATERIAL continued)**

**"THIS IS TO CERTIFY THAT THE ABOVE NAMED MATERIALS ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELED AND ARE IN PROPER CONDITION FOR TRANSPORT ACCORDING TO THE APPLICABLE REGULATIONS OF THE DEPARTMENT OF TRANSPORTATION".**

**Due to the depleted uranium used as shielding in the source changer, a notice must also be enclosed in or on the package, included with the packing list, or otherwise forwarded with the package. This notice must include the name of the consignor or consignee and the following statement:**

**THIS PACKAGE CONFORMS TO THE CONDITIONS AND LIMITATIONS SPECIFIED IN 49 CFR 173.424 FOR EXEMPTED RADIOACTIVE MATERIAL, ARTICLES MANUFACTURED FROM DEPLETED URANIUM, UN 2909".**

**B. Exposure Device/Source Changer - Empty Uranium Shielded Containers.**

- 1. For shipment of an empty exposure device/source changer, assure that there is no source in the container. If the radiation level is below 0.5mR/hr at the surface, no label is required. Mark the outside of the package with the proper shipping name:**

**"RADIOACTIVE MATERIAL, ARTICLES MANUFACTURED FROM DEPLETED URANIUM, UN 2909".**

**Mark the outside of the package:**

**"EXEMPT FROM SPECIFICATION PACKAGING, SHIPPING PAPER AND CERTIFICATION, MARKING AND LABELING AND EXEMPT FROM THE REQUIREMENTS OF PART 175 PER 49 CFR 173.421-1 AND 49 CFR 173.424".**

**Additionally, a notice must be enclosed in or on the package included with the packing list or otherwise forwarded with the package. This notice must include the name of the consignor or consignee and the statement:**

**"THIS PACKAGE CONFORMS TO THE CONDITIONS AND LIMITATIONS SPECIFIED IN 49 CFR 173.424 FOR EXEMPTED RADIOACTIVE**

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**(SHIPPING OF RADIOACTIVE MATERIAL continued)**

**MATERIALS, ARTICLES MANUFACTURED FROM DEPLETED URANIUM,  
UN 2909".**

2. **If the surface radiation level exceeds 0.5mR/hr, measure the radiation level at one meter from the surface, use the criteria of Figure 8-1 to determine the proper shipping labels to be applied to the package. Mark the outside of the outer shipping package with the proper shipping name and identification number:**

**"RADIOACTIVE MATERIAL, LSA, N.O.S., UN 2912".**

**If the container is packaged inside a crate or other outer packaging, mark the outer package with the statement:**

**"INSIDE PACKAGE COMPLIES WITH PRESCRIBED SPECIFICATIONS".**

3. **Properly complete the shipping papers, including:**

- \* **Proper shipping name and identification number (i.e Radioactive Material, LSA n.o.s. UN 2912 or 2909).**
- \* **Name of the radionuclide (i.e depleted uranium-238).**
- \* **Physical and chemical form (i.e Solid Metal).**
- \* **Activity of the source in curies.**
- \* **Category of label applied (e.g. Radioactive Yellow II).**
- \* **Transport Index.**
- \* **USNRC identification number or DOT specification number (i.e USA/9032/B(U) or DOT-7A).**
- \* **For export shipments, the IAEA identification number (i.e USA/9032/B(U)).**
- \* **Shipper's Certification:**

**"THIS IS TO CERTIFY THAT THE ABOVE NAMED MATERIALS ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELED AND ARE IN PROPER CONDITION FOR TRANSPORT ACCORDING TO THE APPLICABLE REGULATIONS OF THE DEPARTMENT OF TRANSPORTATION".**

- C. **Empty Packages - Which Previously Contained Radioactive Material.**

1. **Assure that the package does not contain a radioactive source.**

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**(SHIPPING OF RADIOACTIVE MATERIAL continued)**

2. If the shipping package is to be placed inside a crate or other outer packaging, the outer packaging must be strong enough to withstand normal conditions of transport and must not reduce the safety of the package. The shipping package must be placed within the outer package with sufficient blocking to prevent shifting during transportation.
3. Survey the package at the surface. Assure that the surface radiation level does not exceed 0.5 mR/hr. Assure that any labels which had been previously applied are removed, obliterated or covered.

Affix an "EMPTY" label to the package.

4. Mark the outside of the package with the proper shipping name and identification number:

**"RADIOACTIVE MATERIAL, EMPTY PACKAGE, UN 2908"**

and the statement:

**"EXEMPT FROM SPECIFICATION PACKAGING, SHIPPING PAPER AND CERTIFICATION, MARKING AND LABELING AND EXEMPT FROM THE REQUIREMENTS OF 49CFR PART 175 PER 49CFR 173.421-1 AND 49CFR 173.427".**

5. Additionally, a notice must be enclosed in or on the package, included with the packing list or otherwise forwarded with the package. The notice must include the name of the consignor or consignee and the statement:

**"THIS PACKAGE CONFORMS TO THE CONDITIONS AND LIMITATIONS SPECIFIED IN 49CFR 173.424 FOR EXEMPTED RADIOACTIVE MATERIAL, EMPTY PACKAGES, UN 2908".**

**8.3 AIR SHIPMENT**

For air shipments the package must be labeled with a **"CARGO AIRCRAFT ONLY"** label and the shipping papers must state:



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(AIR SHIPMENT continued)

**"THIS SHIPMENT IS WITHIN THE LIMITATIONS PRESCRIBED FOR  
CARGO - ONLY AIRCRAFT".**

**8.4 GENERAL**

1. Each package of radioactive material shall have a separate bill of lading or air bill and identified with its proper shipping name of "Radioactive Material Special Form NOS" or "Radioactive Material LSA, NOS" as identified above.
2. Complete a Radioactive Material Shipping Record (see attachment 7) for each package of radioactive material. Distribute as follows:
  - \* A copy placed in the shipping container.
  - \* Two copies attached to the bill of lading or Air Bill.
  - \* A copy forwarded to the Radiation Safety Officer.
  - \* A copy in the unit's operational file.
3. Ensure that vehicles utilized in transporting packages labeled "Radioactive Level III" are placarded "RADIOACTIVE" on all four sides.

**8.5 RECORDS**

The following records shall be maintained for a minimum of three years.

- \* Radioactive Material Receipt Inspection Report.
- \* Radioactive Material Shipping Record.

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## **9.0 10 CFR PART 21 REQUIREMENTS**

### **9.1 RESPONSIBILITY**

**It is the responsibility of all personnel involved with industrial radiography to identify any safety hazards or conditions adverse to quality which represent:**

- A. A noncompliance with the Atomic Energy Act of 1954, as amended, or any applicable rule, regulation, order, or license of the NRC relating to substantial safety hazards; or**
- B. A defect in a basic component supplied to the licensed activity.**

### **9.2 IDENTIFICATION**

**Any person who has concerns about such matters are encouraged to first identify them to their immediate supervisor and/or the RSO or Asst. RSO. If the concerns are not acted upon or resolved, then the individual should contact the Director Nuclear Services Department, CSC. Names and telephone extensions of the RSO and Asst. RSO are listed in Figure 9-1.**

**If a satisfactory resolution to the concern has not been provided by the individuals above, then it may be referred directly to the NRC in accordance with the NRC Form 3, Notice to Workers (See Figure 9-2), which provides directions for such a contact.**

### **9.3 NOTIFICATION**

**When the condition is identified as a reportable condition or a potentially reportable condition pursuant to 10CFR21, then the responsible CSC Executive or designee shall notify the Principal Inspector or his alternate at the applicable U.S. NRC regional office within 24 hrs. This notification shall be documented and copies distributed to management and all individuals involved.**

### **9.4 REPORTING**

**A written report shall be prepared, outlining the information listed below and filed with the NRC office(s) IAW 10CFR21 no later than 30 days after notification to the NRC regional office. As a minimum this report shall consist of the following:**

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( REPORTING continued)

- A. Identification of the activity or basic component supplied which fails to comply or contains a defect.
- B. Identification of the firm supplying the basic component which fails to comply or contains a defect.
- C. The nature of the defect or failure to comply and the safety hazard which is created or could be created by such defect or failure to comply.
- D. In the case of the basic component which contains a defect or fails to comply, the number and location of all such components.
- E. The corrective action which has been, is being, or will be taken; the name of the individual or organization responsible for the action; and the length of time that has been or will be taken to complete the action.
- F. Any advice related to the defect or failure to comply about the facility, activity or basic component that has been, is being, or will be given to other purchasers or licensees.

If all the required information is not available, an interim report shall be filed to meet the 30 day reporting requirement. The interim report shall provide a description of the problem, measures being taken, planned corrective action and establish the scheduled date for submittal of the final report.

**9.5 POSTINGS**

The following documents shall be posted where radiographic exposure devices are stored and where radiographic operations are frequented.

- A. NRC Form 3 "Notice to Workers"
- B. Section 206 of the Energy Reorganization Act of 1974 (see attach. 18).
- C. List of responsible CSC employees (with a reference as to where copies of this procedure and 10CFR21 may be viewed or obtained)



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**FIGURE 9-1, RESPONSIBLE CSC EMPLOYEES**

.....  
**NOTICE**  
**IN CASE OF AN EMERGENCY OR ACCIDENT INVOLVING**  
**THIS VEHICLE OR RADIOACTIVE MATERIAL STORAGE AREA**  
.....

**NOTIFY:**  
CENTERIOR SERVICE COMPANY  
NONDESTRUCTIVE EXAMINATION SECTION  
PERRY NUCLEAR POWER PLANT  
10 CENTER RD.  
PERRY, OHIO 44081

Call: 216-259-3737  
216-622-9800  
216-951-5322

Ask for Perry extension 6255, 6257 or 6320

**Evenings, Weekends or Holidays Call:**

Hudson Walls (RSO) - 216-257-2928

or

Gordon Gayton (A.RSO) - 216-428-7169

(CALL ANY OF THE ABOVE NUMBERS COLLECT IF NECESSARY)

.....  
The following documents are available for review  
at the above listed address or the mobile laboratory

- 10 CFR Part(s) 19, 20, 21, 34, 71
  - Section 206 of the Energy Reorganization Act of 1974
  - CSC - Industrial Radiography Program
  - USNRC License
- .....



UNITED STATES NUCLEAR REGULATORY COMMISSION  
 Washington, D.C. 20555  
**NOTICE TO EMPLOYEES**  
 STANDARDS FOR PROTECTION AGAINST RADIATION PART 21, NOTICE, INSTRUCTIONS AND  
 REPORTS TO WORKERS UNDER 10MFC PART 21, EMPLOYEE PROTECTION

**WHAT IS THE NUCLEAR REGULATORY COMMISSION?**  
 The Nuclear Regulatory Commission is an independent Federal regulatory agency in the Executive Branch of the Government. Its primary responsibility is to regulate the use of nuclear energy for peaceful purposes. The Commission is authorized to issue orders and to conduct investigations and enforcement actions.

**WHAT DOES THE NRC DO?**  
 The NRC's primary responsibility is to ensure that nuclear energy is used safely and that the public and the environment are protected from potential hazards. The NRC also regulates the use of nuclear energy for peaceful purposes, such as the production of electricity and the use of nuclear medicine.

**HOW DO I REPORT VIOLATIONS?**  
 If you observe a violation of the NRC's regulations, you should report it to the nearest NRC Regional Office. You can also report a violation to the NRC's toll-free hotline at 1-800-368-7632.

**WHAT IF I WORK IN A RADIATION AREA?**  
 If you work in a radiation area, you must follow the NRC's regulations to ensure your safety and the safety of others. This includes wearing protective clothing, using proper work practices, and following safety procedures.

**HOW ARE VIOLATIONS OF NRC REGULATIONS IDENTIFIED?**  
 Violations of NRC regulations can be identified in several ways. They can be reported by workers, the public, or the NRC's inspectors. The NRC also conducts inspections of radiation areas to ensure compliance with its regulations.

**CAN I BE FINED FOR TALKING TO THE NRC?**  
 No, you cannot be fined for talking to the NRC. In fact, you are encouraged to report any violations you observe. The NRC's inspectors are trained to investigate and resolve any issues that may arise.

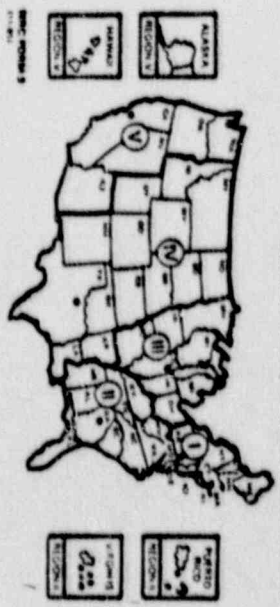
**WHAT KINDS OF DISCIPLINE CAN BE PROMOTED?**  
 The NRC has the authority to impose disciplinary actions on workers who violate its regulations. This can include fines, suspension, or termination. However, the NRC also has a process for resolving disputes and for providing assistance to workers who may be affected by a violation.

**HOW ARE I PROTECTED FROM DISCRIMINATION?**  
 The NRC is committed to ensuring that workers are protected from discrimination. This includes protecting workers from retaliation for reporting a violation or for participating in an NRC investigation. The NRC also has a process for resolving discrimination complaints.

**WHAT CAN THE LABOR DEPARTMENT DO?**  
 The Department of Labor has the authority to enforce Federal labor laws, including laws that protect workers from discrimination. If you believe you have been discriminated against, you should contact the Department of Labor for assistance.

**WHAT WILL THE NRC DO?**  
 The NRC will take all necessary actions to ensure compliance with its regulations. This includes conducting inspections, investigating violations, and imposing disciplinary actions. The NRC also provides technical assistance and training to workers to help them understand and follow the regulations.

FIGURE 9-2, NRC FORM 3



REGION	ADDRESS	TELEPHONE
1	1100 North 17th Street Albuquerque, NM 87102	505 827-8800
2	1100 North 17th Street Albuquerque, NM 87102	505 827-8800
3	1100 North 17th Street Albuquerque, NM 87102	505 827-8800
4	1100 North 17th Street Albuquerque, NM 87102	505 827-8800
5	1100 North 17th Street Albuquerque, NM 87102	505 827-8800
6	1100 North 17th Street Albuquerque, NM 87102	505 827-8800
7	1100 North 17th Street Albuquerque, NM 87102	505 827-8800
8	1100 North 17th Street Albuquerque, NM 87102	505 827-8800
9	1100 North 17th Street Albuquerque, NM 87102	505 827-8800
10	1100 North 17th Street Albuquerque, NM 87102	505 827-8800

UNITED STATES NUCLEAR REGULATORY COMMISSION REGIONAL OFFICE LOCATIONS  
 A representative of the Nuclear Regulatory Commission may be contacted at the following address and telephone number. The Regional Office and nearest office telephone with hours of operation will be supplied upon request. Address and telephone number of the nearest office will be supplied upon request.

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## **10.0 PERSONNEL MONITORING**

### **10.1 DOSIMETERS**

1. Dosimeters are stored in a locked cabinet, located in an area of low background radiation.
2. All individuals shall wear a pocket dosimeter (0- 200mR) at all times when working with or around radiographic exposure devices. Dosimeters will be worn on the outer clothing, between the waist and neck area, adjacent to the TLD.
3. Prior to beginning radiographic activities, dosimeters shall be re-charged and the reading logged on the individuals Weekly Dosimeter Log (see attach. 16).
4. Dosimeters are to be checked at frequent intervals during radiographic activities so that you are aware of the exposure received.
5. In the event a dosimeter goes off scale due to unknown circumstances, secure the source, cease radiographic activities and have other individuals check their dosimetry, then contact the RSO or Asst. RSO for instructions, in accordance with Section 17 Emergency Instructions.
6. After completion of radiographic activities for the day or work period, log final dosimeter reading and indicated dose on the Weekly Dosimeter Log and return dosimeters to the storage area.

### **10.2 DOSIMETER CALIBRATION**

1. Dosimeters are to be calibrated on an annual basis as follows:
  - A. Zero the dosimeter on a dosimeter charger.
  - B. Place dosimeter in the dosimeter calibrator for the specified time.

**EXAMPLE:** If utilizing a Dosimeter Corporation of America, Dosimeter Calibrator, Model 3060, place dosimeters in the 4 inner holes for 6 hrs. and/or in the 8 outer holes for 24hrs. The dosimeters should measure a nominal response of 50mR.



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**(DOSIMETER CALIBRATION continued)**

- C. Remove the dosimeter after the calculated time per the calibrator source decay curve and log the results on the Dosimeter Calibration Log (see attachment 2).

The dosimeter should read  $\pm 30\%$  of the true radiation exposure (Example: for a known exposure of 50mR the dosimeter must be between 35mR and 65mR). Affix a new calibration sticker to the dosimeter. If the dosimeter is unable to detect  $\pm 30\%$ , remove the old calibration sticker, take the dosimeter out of service and report the fact to the Asst. RSO for disposition of repair or replacement.

**10.3 TLD'S**

1. TLD's are stored in a locked cabinet, located in an area of low background radiation when not in use.

**NOTE:** Control TLD's are not to be worn by any individual.

2. TLD's shall be individually assigned on a monthly basis and worn only by those assigned individuals. The RSO or his designee is responsible for assigning and collecting TLD's on a monthly basis.
3. TLD's are to be worn on the outer clothing between the neck and waist area at all times when working with or around radiographic exposures devices. Care should be taken to prevent TLD's from becoming wet or damaged.
4. Individuals shall notify the RSO or Asst. RSO in accordance with Section 17, Emergency Instructions, when any of the following events occur:
- A. The possibility exists that an excessive radiation exposure may have occurred;
  - B. An individuals TLD becomes lost or damaged;
  - C. An individual has reason to believe that his/her TLD may have received dosage that the individuals body did not receive.
5. Upon completion of radiographic operations for the day or work period, return the TLD to the storage cabinet.

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### 10.4 SURVEY INSTRUMENTS

1. Survey instruments used to perform industrial radiography shall have a range of at least 2mR/hr to 1000mR/hr.
2. Individuals using survey instruments shall check the overall condition and operability of the unit prior to its use (ie: battery level, zeroing scale [if required] etc).
3. Instruments should have a two minute warm-up period with the selector switch set at the lowest setting, prior to "zeroing" (if required) and use.
4. Calibration of survey instruments shall be at intervals not to exceed three months or after servicing, and calibrated in accordance with approved Perry Nuclear Power Plant (License No. NPF-58), Radiation Protection Section, calibration procedures.

### 10.5 RECORDS

1. TLD results shall be maintained until the NRC authorizes disposal.
2. Dosimeter calibration records are to be maintained for a minimum of three years.
3. Survey instrument calibration records are to be maintained for a minimum of three years in accordance with Perry Nuclear Power Plant, Radiation Protection Section procedures.

## **11.0 RADIATION SURVEYS AND POSTINGS**

### **11.1 POSTINGS**

The following documents may be examined at the Nondestructive Examination Section office, and at all radiographic source storage locations or at the plants or sites where radiographic operations take place, to permit individuals frequenting the area to observe them:

- 10 CFR Parts 19, 20, 21, 34 and 71
- CSC's Material License
- Form NRC-3, Notice to Employees
- Section 206 of the Energy Reorganization Act of 1974
- Notices of Violation [per 10 CFR Part 19, 19.11 (a) (4)]

### **11.2 RADIATION SURVEYS**

1. The use of radiation survey instruments allows the Radiographer and/or Radiographers's Assistant to establish safety perimeters where applicable radiation area signs and barricades can be erected as required.
2. Safety perimeters (yellow and magenta rope, warning signs, etc) shall be established for each exposure set-up. The safety perimeter is established at the point such that the total quantity of radiation in any one hour does not exceed 2mR. The Radiographer and/or Radiographer's Assistant shall maintain continuous surveillance of Radiation Areas to prevent unauthorized entry.
3. Signs used at the perimeters of the radiation area and high radiation area must comply with applicable federal regulations and shall be placed as follows:
  - A. Radiation Area - An area within which the radiation level exceeds 2mR/hr. The sign "Caution- Radiation Area" shall be placed conspicuously at the perimeters of this area. (See Example, Figure 11-1A).
  - B. High Radiation Area - A survey need not be made to determine the High Radiation Area since this would result in unnecessary exposure to the Radiographer or Radiographer's Assistant. Instead the sign "Caution-High



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**(RADIATION SURVEYS continued)**

Radiation Area\* shall be placed at the perimeter of the area with a calculated radiation level in excess of 100mR/hr. (See Example, Figure 11-1B).

4. After each radiographic exposure, a physical radiation survey shall be made to determine that the source has returned to a safe position in the camera. Log the initial results on a Radiographic Operation Report (see attachment 3).

**NOTE:** This survey should be made at the same location relative to the camera after each exposure and must include the entire circumference of the exposure device, the source guide tube and the area at the front of the camera near the port.

5. At the conclusion of each radiographic operation, at the time of securing the source, a physical radiation survey shall be made to determine the source is in the safe position. Additional physical radiation surveys shall be made after the source is disconnected and locked in the camera and at the time of storage in storage area. Record the results on a Radiographic Operations Report.

**NOTE:** Anytime the source is stored in a designated storage area, post the area with the sign \*Caution-Radioactive Material (see example, Figure 11-1C)

**11.3 RECORDS**

1. Notices of Violation - These notices shall be posted within two days of receipt and shall remain posted for a minimum of five days or until the corrective action is completed, whichever is later.
2. Radiographic Operation - These reports shall be maintained for a minimum of three years.

**FIGURE 11-1 EXAMPLE SIGNS**



**A.) CAUTION - RADIATION AREA**

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**B.) CAUTION - HIGH RADIATION AREA**



**C.) CAUTION - RADIOACTIVE MATERIALS**

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## **12.0 OPERATING, LOCKING AND SECURING SOURCES**

### **12.1 GENERAL**

- 1. Only those personnel qualified by CSC as Radiographers and Radiographer's Assistants are authorized to use those radiographic exposure devices and sealed sources stipulated on CSC's material license issued by the NRC.**

**NOTE: Radiographer's Assistants must be under the direct surveillance of a radiographer.**

- 2. Each radiographic exposure device, storage container or source changer shall be provided with a lock to prevent unauthorized or accidental removal or exposure of a sealed source and shall be kept locked at all times except when conducting radiographic operations under the control and direct surveillance of the Radiographer or Radiographer's Assistant.**

### **12.2 PRE-OPERATION**

- 1. The Radiographer and/or Radiographer's Assistant shall perform the following prior to engaging in radiographic operations:**
  - A. Ensure that personnel are wearing the required dosimetry.**
  - B. At least one calibrated and operable survey instrument is present. The operability of the survey meter can be checked by reading the radiation level at the surface of the exposure device. It should read no more than 200mR/hr.**
  - C. Survey the camera for excessive radiation levels. If excessive levels are present, notify the RSO or Asst. RSO.**
  - D. Inspect the camera for damage to the connector, lock, fittings and fasteners.**
  - E. Inspect the control unit assembly for damage to connectors, loose hardware and cable for breaks, kinks and freedom of operation.**
  - F. Inspect source guide tubes for cuts, breaks, dents, broken or loose fittings and damaged threads.**



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(PRE-OPERATION continued)

- G. If collimators are to be used, inspect them for dirt or other obstructions, damage or galling of threads and ensure that they can be securely attached to the source guide tube.
- H. If source positioner (such as J-Tubes or centering devices) is used, inspect for dirt or other obstructions, damage or kinking of tube, end cap for looseness or damages and threads for damage or galling.
- I. Establish safety perimeters per Section 11.

### 12.3 ASSEMBLY

1. The Radiographer and/or Radiographer's Assistant shall assemble the exposure device in accordance with the following guidelines(\*). If necessary refer to the manufacturer's manual for additional guidance.

- \* Depending on the particular application steps 12.3.1 A thru E may be worked in a different order.

Amersham Corp. Model 660

- A. Position and secure the source stop of the master source guide tube or collimated guide tube or guide tube and source positioner at the radiographic focal position.

NOTE: Wherever possible use a collimator to reduce the levels of unnecessary primary and scatter radiation

- B. Determine where the exposure device will be positioned and connect the extender source guide tubes together as required, laying them as straight as possible. Where practical bends should have a radius of at least 20 inches.

WARNING: Never operate the system with more than three guide tube sections (21 feet). If using a screw-on type collimator or source positioner, never operate the system with more than two guide tube sections (14 feet).

- C. Remove the storage plug from the front of the exposure device, measure the radiation level at the opening and then connect the source guide tube to the exposure device.

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(ASSEMBLY continued)

- D. Connect the control unit to the exposure device, refer to Figures 12-1 through 12-5.
- E. Determine where the control unit will be positioned (as far away from the radiographic focal position as possible and preferably behind a radiation shield) and lay out the control housing. Where practical bends should have a radius of at least 36 inches.
- F. Before operation, check all connections and bend radii, and the position of the source stop, which represents the radiographic focal position of the source.
- G. Prior to exposing the source, check the established restricted area to assure that no one has entered and that the appropriate radiation warning signs have been posted in accordance with Section 11. Clear all personnel from the area.

### 12.4 OPERATION

1. The Radiographer and/or Radiographer's Assistant shall conduct radiography in accordance with the following guidelines:

Amersham Corp. Model 660

- A. Unlock the exposure device and then the selector ring to the "operate" position.
- B. Rapidly rotate the crank in the EXPOSE direction to move the source to the radiographic focal position.
- C. When the source reaches the source stop, the hand crank will stop turning. Never exert more than 5 ft-lbs of torque on the hand crank, as this may cause damage to the control unit or drive cable. Set the brake (if so equipped) to ON to prevent movement of the source during the exposure.
- D. Begin the specimen exposure time from the moment the source reaches the source stop.

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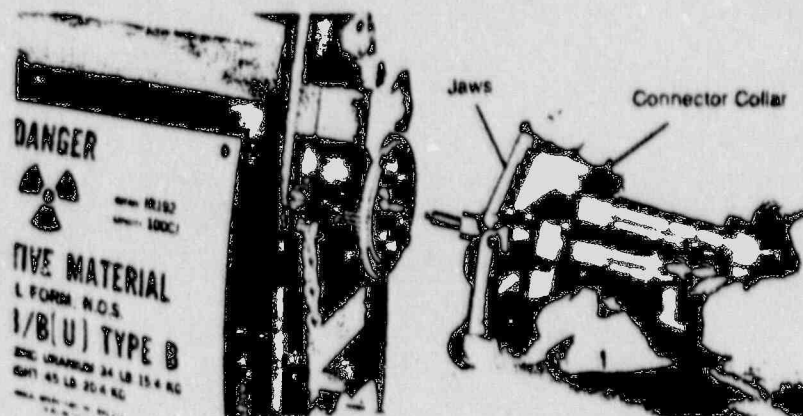
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Figure 12-1



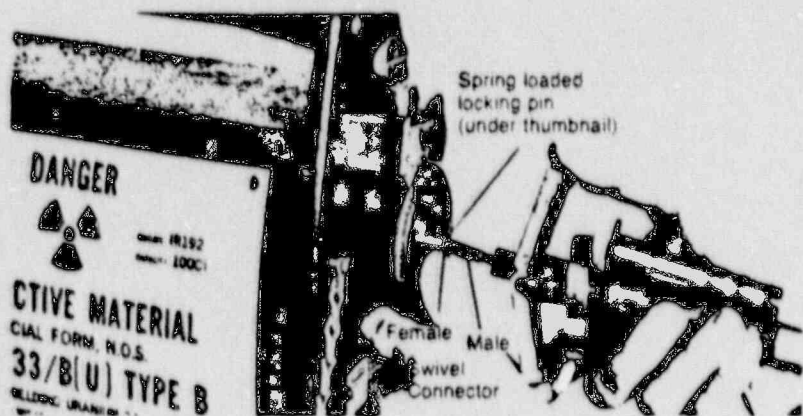
Unlock the exposure device with the key provided and turn the selector ring from the LOCK position to the CONNECT position. When the ring is in the CONNECT position, the storage cover will disengage from the exposure device as shown.

Figure 12-2



Slide the Model 661 connector collar back and open the jaws of the Model 661 connector. This exposes the male portion of the swivel type drive cable connector as shown.

Figure 12-3



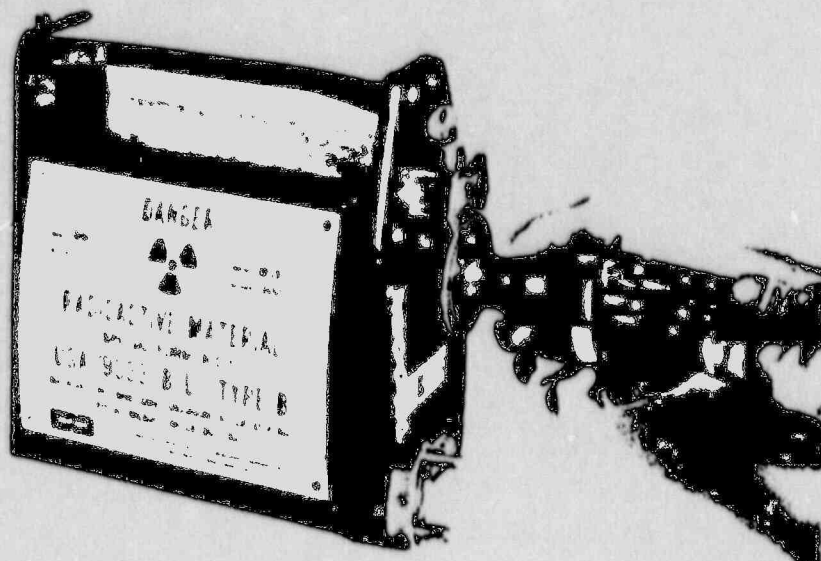
Engage the male and female portions of the swivel connector as shown by depressing the spring-loaded locking pin toward the exposure device with the thumbnail. Release the locking pin and test that the connection has been properly made.



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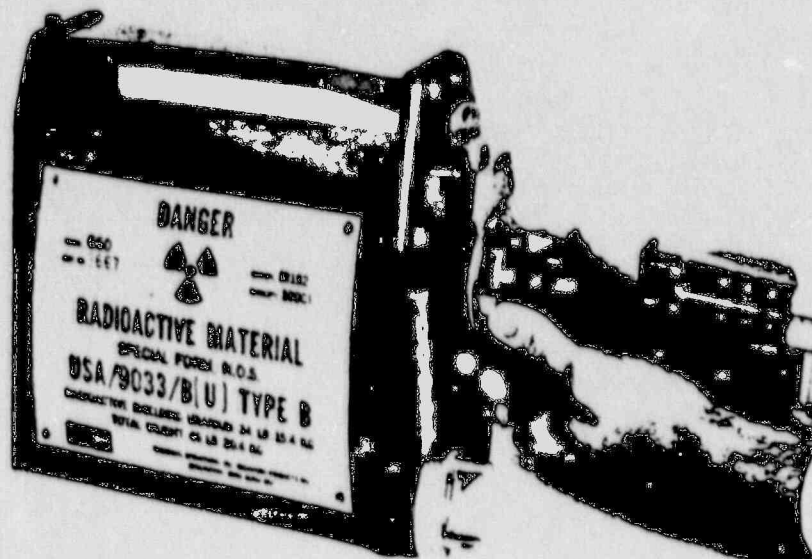
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Figure 12-4



Close the jaws of the Model 661 connector over the swivel connector.

Figure 12-5



Slide the Model 661 connector collar over the connector jaws. Hold the collar flush against the control unit connector and rotate the selector ring from the CONNECT position to the LOCK position. Keep the exposure device locked until operation is ready to start.

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(OPERATION continued)

- E. During the exposure, maintain continuous surveillance of the safety spending as little time as possible in the Radiation Area to minimize exposure.
- F. To return the source to the exposure device after the desired exposure time elapsed, turn the brake (if so equipped) to OFF and rapidly turn the crank RETRACT direction until the crank will no longer move.
- G. Approach the exposure device with the survey meter and survey the exposure device on all sides. The meter should indicate the same radiation level as observed prior to radiographic operations and after each exposure.
- H. Survey the entire source guide tube and collimator (if attached) with the survey meter. If the meter shows a sharp increase, the source could still be exposed or incompletely shielded.
- I. If the source is still exposed, leave the Radiation Area and attempt to store it properly by cranking the source a short distance toward the source stop or collimator and retracting it, repeating if necessary.
- J. If the source becomes jammed in an exposed position, do not try to retrieve the source. Treat the situation as an emergency and refer to Section 17.
- K. When the source is properly stored in the exposure device, rotate the selector ring from the OPERATE position to the LOCK position and secure it with the exposure device lock.

NOTE: If the selector ring cannot be rotated to the LOCK position, the source has not been fully retracted. Turn the hand crank to the full RETRACT position.

- L. Record the results on a Radiographic Operations Report.

### 12.5 POST-OPERATION

- 1. After performing the radiography, the Radiographer and/or Radiographer's Assistant will perform the following disassembly and post-operation items.

TECH/OPS Model 660

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**(POST-OPERATION continued)**

- A. Unlock the exposure device, and rotate the selector ring from LOCK to CONNECT. The control unit connector will partially disengage.**
- B. Refer to Figures 12-1 through 12-5 to disengage the control unit from the exposure device.**
- C. Replace the storage cover in the control unit connector and rotate the selector ring to the LOCK position. Remove the key and engage the lock to secure the exposure device. Survey the entire circumference of the exposure device with the survey meter to ensure the source is properly secured.**
- D. Unscrew the source guide tube sections and remove the master guide tube from the radiographic focal position. Protect the threads and cover the ends of the tubes and control cable connectors to eliminate dust and dirt from entering.**
- E. Insert the storage plug into the guide tube connector and tighten.**
- F. Perform a final physical survey to determine again that the source is in its properly shielded position. Document the results on a Radiographic Operations Report (see attachment 3).**
- G. Return the exposure device and equipment to the designated storage area and perform a "Time of Storage" physical survey.**
- H. Lock the designated storage area and complete the Radiographic Operations Report.**

### **12.6 RECORDS**

The Radiographic Operations Report shall be maintained for a minimum of three years after completion.



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## **13.0 QUARTERLY INVENTORY AND MAINTENANCE**

### **13.1 PHYSICAL QUARTERLY INVENTORY AND MAINTENANCE**

The Assistant RSO shall ensure that the following maintenance, inspection and inventory requirements are performed on a Quarterly basis and documented on a Quarterly Inventory/Periodic Maintenance Report and Quarterly Inventory Log. (See attachment 1 and 1a).

- 1. Inventory of Sealed Sources - This includes documenting types of byproduct material, quantity, location, and date of inventory.**
- 2. Radiation Survey - Ensure that the radiation levels do not exceed 200mR/hr at the surfaceNDR exceed 2 mR/hr at 18 inches from the storage area surface.**
- 3. Inspect the overall condition of the exposure device noting any areas of concern which could impair the safe operation of the equipment. For exposure devices pay particular attention to the locking mechanism, ensuring that the lock operates smoothly. Clean and lubricate the lock if necessary.**

### **13.2 PERIODIC MAINTENANCE**

- 1. At the time of source change operations (after the old source has been secured in the source changer), the source control unit, crank assembly and exposure device shall be disassembled, cleaned, inspected and lubricated in accordance with the manufacturer's operation and maintenance manual(s). Document the periodic maintenance on a Quarterly Inventory/Periodic Maintenance Report.**
- 2. After re-assembly of the equipment, check the equipment for proper operation and labeling.**
- 3. Load the new source into the exposure device in accordance with Section 16 and perform a Quarterly Inventory as described above in para. 13.1.**

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**13.3 RECORDS**

**The Quarterly Inventory/Periodic Maintenance Report shall be maintained for a minimum of three years after completion.**

## 14.0 TRANSPORTATION AND VEHICLE STORAGE OF SOURCES

### 14.1 TRANSPORTING RADIOGRAPHIC SOURCES

This section applies to transporting radiographic exposure devices and source changers to and from work and storage areas by vehicle (for shipping and receiving see Section 8).

This procedure applies to all radiographic personnel that have responsibility for transportation and storage of all the above listed equipment.

### 14.2 LOADING VEHICLE

- A. Ensure that personnel are wearing the required dosimetry and that an operable calibrated survey meter is utilized.
- B. Check the vehicle, make sure it is in good operating condition and as a minimum, a sufficient quantity of safety equipment such as radiation area signs, rope, calibrated survey meters and proper shipping papers are present.
- C. Place the exposure device and/or source changer in the vehicle storage container, secure against movement and lock the container. Ensure that the storage container is labeled:

**"INSIDE PACKAGE COMPLIES WITH PRESCRIBED SPECIFICATION".**

Survey the drivers and passenger seating area(s) to ensure that radiation levels are below 2mR per hour.

- D. Survey the shipping container surface and select the proper shipping label (refer to Section 8, Fig. 8-1). Measure the radiation level at 3.3 feet from the exterior surface and enter the Transportation Index (T.I.) on the shipping label.
- E. If the radiation levels of the exposure device/source changer or shipping container are such that it requires a Radioactive Yellow III Label, the vehicle must display "Radioactive" placards (see Figure 14-1) on all four sides.



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**14.3 STORING RADIOGRAPHIC SOURCES IN VEHICLES**

- A. In the event that the vehicles are used for storage, conduct a survey to ensure that radiation levels are less than 2mR per hour at a distance of 18 inches from the surface of the vehicle (2 days max. see note). Also the vehicle storage container shall be posted with "Caution-Radioactive Material" Sign.**

**NOTE: If storing in a vehicle for longer than 2 days, ensure that the radiation levels on the exterior surface are less than .6 mR/hr as to not exceed the 100 mR in a 7 day period limit.**

- B. Perform a time of storage survey and document the results on the Radiographic Operation Report.**

**14.4 VEHICLE ACCIDENT**

**In the event of an accident involving the vehicle used to transport the source, refer to Section 17.0 "Emergency Instructions".**

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FIGURE 14-1



## **15.0 LEAK TESTS**

### **15.1 GENERAL**

**Only qualified Radiographers who have been instructed in leak testing and have demonstrated satisfactory performance to the Radiation Safety Officer may conduct leak tests.**

**All applicable radiation safety precautions shall be maintained throughout the performance of the test.**

### **15.2 PERFORMANCE OF TEST**

#### **A. Source Leak Test**

**Radiographic sources contained in an exposure device shall be leak tested at intervals not to exceed 6 months to ensure that the level of removable contamination is not in excess of 0.005 microcuries (11,100 disintegrations per minute [dpm]).**

**Moisten the leak test swab with de-ionized water or Isopropyl alcohol, remove the exposure device shipping plug, and wipe the inside of the S-Tube and end of the shipping plug. Re-install the shipping plug and place the swab in a plastic envelope. Check the sample with a survey meter (in an area of low [less than 2mR/hr] background radiation), ensuring the sample is 2mR/hr or less before taking the sample for evaluation.**

#### **B. Sample Survey**

**If the sample indicates a radiation level greater than 2mR/hr, do not send the sample for evaluation and notify the RSO immediately.**

**Document the required information on the Leak Test Data Sheet (see attach. 8) .**



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**15.3 SAMPLE EVALUATION**

**Test samples and Leak Test DataSheets shall be taken to the Health Physics Unit at Perry Nuclear Power Plant. Samples shall be evaluated (counted) by qualified personnel utilizing calibrated equipment in accordance with PNPP (License No. NPF-58), Radiation Protection Section procedures.**

**Health Physics Unit personnel shall document the required information on the data sheet and return it to the RSO.**

**NOTE: If the leak test results indicate excessive contamination levels notify the RSO immediately.**

**15.4 TEST RESULTS**

**A. Source Leak Test**

**If the Leak Test results are greater than 0.005 microcuries (11,100 dpm), the RSO shall immediately withdraw the equipment from service and notify the NRC regional office. A written report shall be filed within 5 days in accordance with applicable federal regulations.**

**If the leak test results are found acceptable, complete the Leak Test Data Sheet and affix a Leak Test sticker (attach. 17) to the exposed device.**

**15.5 RECORDS**

**Leak Test Data Sheet shall be maintained for at least six months after the next required leak test or until the source is disposed of.**

## **16.0 SOURCE CHANGES**

### **16.1 QUALIFICATION**

**Only qualified Radiographers who have been instructed in the operation of source changers and have demonstrated satisfactory performance to the Radiation Safety Officer may conduct source change operations.**

### **16.2 LEAK TEST**

**No sealed source will be put into a camera without evidence of having a leak test performed within the previous six months. New sources may show evidence of a leak test on the supplied source decay curve. Older sources may show evidence on a Leak Test Data Sheet.**

### **16.3 OPERATION**

**Ensure a calibrated and operable survey meter is used while performing the following steps:**

#### **1. Amersham Corp. MODEL 650**

**Exchanging Source - From Exposure Device to Source Changer**

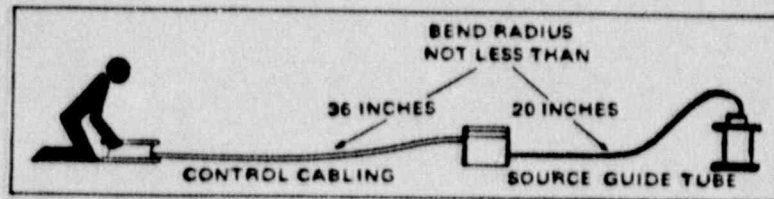
- A. Locate the source changer and radiographic exposure device in a restricted area as established in Section 11. Arrange them so that one length of guide tube will fit between them without any sharp bends or kinks in the tube. The bend radius of the source guide tube during source changing operations should be greater than 20 inches (when practical).**

**NOTE: THE SOURCE CHANGER MUST REMAIN UPRIGHT AT ALL TIMES. DO NOT LAY THE SOURCE CHANGER ON ITS SIDE.**

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**FIGURE 16-1 Typical Source Exchange Arrangement**

- B. Connect the Control Unit to the exposure device in accordance with Section 12. Locate the control housing as far away as possible from the exposure device and the source changer and preferably behind any available radiation shielding.**
- C. Remove the outer cover from the source changer by unlocking the padlock and breaking the seal wire and removing bolts.**
- D. Remove the source holdown cap that covers the source by breaking the seal wire and unbolting. Remove the identification plate for the new source.**

**NOTE: WHEN THE SOURCE HOLDOWN CAP IS REMOVED, THE SOURCE CONNECTOR IS EXPOSED. CARE MUST BE TAKEN TO ASSURE THAT THE SOURCE IS NOT DISLODGED WHEN HANDLING THE CHANGER.**

- E. Connect one end of the guide tube extension to the exposure device and the other end to the fitting above the empty chamber of the source changer.**
- F. Close and latch the source guides. Assure no unauthorized personnel are in the restricted area and all access points are secured.**
- G. Position survey meter close to the operation control point so as to continuously monitor dose rate to which operator is exposed.**

CONTROL CONTROL 7/4 5 8



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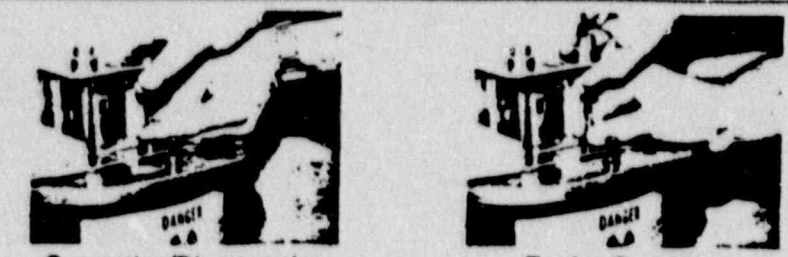
**(OPERATION continued)**

- H. At the exposure device controls, crank the source rapidly from the exposure device to the source changer. The radiation intensity should greatly increase as the source is first exposed, decrease slightly as the source is being cranked out from the exposure device to the source changer and then drop to background when the source is in the source changer.**
- I. Approach the exposure device with a survey meter; survey the exposure device on all sides, survey the guide tube and survey the source changer on all sides to assure the source has been properly transferred and stored. The maximum radiation level should be less than 200mR/hr at the surface of the source changer and less than 10mR/hr one meter from the surface of the source changer.**
- J. Open the source guides (Note the warning in Figure 16-2). Disconnect the drive cable from the source assembly by moving the lock pin of the source connector down towards the source and slide the drive cable out through the keyway (See Figure 16- 2).**

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**FIGURE 16-2**



**Connecting/Disconnecting**      **Testing Connection**

**Drive Cable Connection**

**WARNING**

Do not move the source assembly more than 1/2 inch from its stored position when connecting and disconnecting or when testing for proper connection.

This procedure should be monitored with an operable calibrated meter.

<p><b>To Engage Connector</b></p> <ol style="list-style-type: none"><li>1. Using a fingernail, move the connector pin forward (pressure on pin is downward stored position of source). This moves the connector sleeve away from the keyway in the female connector.</li><li>2. Slide the drive cable connector into the female connector and release the pin. Assure that the connector sleeve has returned to the original position closing the keyway.</li><li>3. Test the connection by pulling between the source and the drive cable. (NOTE: Warning)</li></ol>	<p><b>To Disengage Connector</b></p> <ol style="list-style-type: none"><li>1. Using a fingernail, move the Connector pin forward (pressure on pin is downward toward stored position of source). This moves the connector sleeve away from the keyway in the female connector.</li><li>2. Slide the drive cable connector out of the female connector and release the pin.</li></ol>
---	--

**CAUTION**

Move connector sideways only.  
Do not bend or twist.



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**K. When the disconnection of the source connector and the drive cable is complete, carefully remove the guide tube from the source changer to assure the source is not accidentally caught and removed.**

**L. Perform the required periodic maintenance in accordance with Section 13. Then connect the control unit to the exposure device in accordance with Section 12.**

**Exchanging Source - From Source Changer to Exposure Device**

**M. Connect the guide tube to the fitting above the chamber containing the new source (Note warning in Figure 16-2).**

**N. Couple the drive cable to the source by depressing the lock pin, sliding the drive cable connector into the keyway and releasing the lock pin. Assure that the connection is secure before continuing. (See Figure 16-2).**

**O. Close and latch the source guides above the new source. Assure no unauthorized personnel are in the restricted area.**

**P. At the exposure device controls, crank the new source from the source changer to its storage position in the exposure device. Observe the survey meter during this operation. The radiation intensity should increase as the source exits the source changer. The radiation intensity should steadily increase as the source travels to the exposure device and drop to background when the source is properly stored in the exposure device.**

**Q. Approach the exposure device with the survey meter, survey the exposure device on all sides, the guide tube and the source changer on all sides to assure the source has been properly transferred to its storage position in the exposure device. Radiation levels should be less than 200mR/hr at the surface and less than 10 mR/hr at one meter from the surface of the source changer.**

**R. When the source is determined to be properly stored, lock the exposure device and remove the guide tube and controls. Disconnect the guide tube from the source changer.**



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**(OPERATION continued)**

- S. Place the source holddown cap over the old spent source in the source changer. Attach the identification plate of the old source to the holddown cap.**
- T. BOLT DOWN THE SOURCE HOLDOWN CAP IN PLACE AND SEAL WIRE. ASSURE THAT THE SOURCE HOLDOWN CAP IS BOLTED DOWN FIRMLY OVER THE SOURCE CONNECTORS).**
- U. Affix the identification plate of the new source to the exposure device.**
- V. Bolt the source changer cover in place and seal wire. Lock the padlock in place. If an outer barrel is used as an over pack, it must be fastened with seal wire.**
- W. Survey all exterior surfaces of the package to assure that the radiation level does not exceed 200mR/hr at the surface or 10mR/hr at one meter (3.3 feet).**
- X. Complete the Source Transfer/Disposal Record (see attachment 6) and forward it to the RSO.**

**2. SPEC Model C-1**

**Exchanging Source - From Exposure Device to Source Changer**

- A. Locate the source changer and radiographic exposure device in a restricted area as established in Section 11. Arrange them so that the short exchange tube supplied with the C-1 source changer will fit between them without any sharp bends or kinks in the tube.**
- B. Open the top door to its fully extended position, exposing the outlet tubes and plungers on the top.**
- C. Pull the lock plunger on the blue side (empty side) and turn to the left. This unlocks the plunger by holding it in the retracted position.**

**NOTE: Once a source has been fully installed within the C-1, the spring-loaded plunger secures it in place by pushing a rod against the pigtail**

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cable directly behind the source capsule. If the plunger is not retracted the source is able to enter the C-1, but WILL NOT be in the shielded area and WILL NOT be able to be secured in place. THE EMPTY SIDE PLUNGER OF C-1 MUST BE RETRACTED BEFORE PROCEEDING.

- D. Connect one end of the source exchange tube to the uncapped outlet tube on the top of the Source Changer. Connect the other end of the exchange tube to outlet of the exposure device.
- E. Connect the Control Unit to the Exposure device in accordance with the Operating Instructions outlined in Section 12.
- F. Assure no unauthorized personnel are in the restricted area and all access points are secured.
- G. Position survey meter close to the operation control point so as to continuously monitor dose rate to which operator is exposed.
- H. At the exposure device controls, crank the source from the exposure device to the source changer. The radiation intensity should greatly increase as the source is first exposed, decrease slightly as the source is being cranked out from the exposure device to the source changer and then drop to background when the source is in the source changer.
- I. Approach the exposure device with a survey meter; survey the exposure device on all sides, survey the guide tube and survey the source changer on all sides to assure the source has been properly transferred and stored. The maximum radiation level should be less than 200mR/hr at the surface of the source changer and less than 10mR/hr one meter from the surface of the source changer.
- K. Lock the changer by turning the lock plunger 1/4 turn to the right and release. The plunger will lock down on the source. The knurled knob of the plunger has to seat on the barrel of the plunger housing. If it does not, jiggle the source with the control cable crank, until it does seat.



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**!! CAUTION !!**

**THE SOURCE COULD BE REMOVED FROM THE LOCK BOX IF THE LOCK IS NOT LOCKED**

- L. Remove the exchange tube from the C-1 blue side and disconnect the control cable from the source pigtail.
- M. Carefully attempt to move the pigtail into and out of the lock box to assure the lock is depressed upon the pigtail. If the pigtail can be moved, pull the lock plunger out and shove the pigtail down into the tube and reseat the plunger.  

**CAUTION: Do not move the pigtail in excess of 1/2 inch, this would move the source from its shielded position.**
- N. Remove protector outlet cap from outlet tube on the red side of the container and place protector cap on tube on the blue side.
- O. Perform the required periodic maintenance in accordance with Section 13. Then connect the control unit to the exposure device in accordance with Section 12.
- P. Attach the control cable to the new pigtail which is on the red side and attach the short exchange tube to the C-1 Source Changer on the red side.
- Q. Pull the lock plunger on the new source side of the Source Changer and turn it 1/4 turn to the left. This unlocks the plunger and the new source is free to be extracted from the Source Changer.
- R. Assure no unauthorized personnel are in the restricted area.
- S. At the exposure device controls, crank the new source from the source changer to its storage position in the exposure device. Observe the survey meter during



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this operation. The radiation intensity should increase as the source exits the source changer. The radiation intensity should steadily increase as the source travels to the exposure device and drop to background when the source is properly stored in the exposure device.

T. Approach the exposure device with the survey meter, survey the exposure device on all sides, the guide tube and the source changer on all sides to assure the source has been properly transferred to its storage position in the exposure device. Radiation levels should be less than 200 mR/hr at the surface and 10mR/hr at one meter from the source changer and from the exposure device.

U. When the source is determined to be properly stored, rotate RED side (now empty) plunger knob until plunger snaps into its original fully engaged (closed) position.

NOTE: Unless both plungers are in the closed position the plunger knobs will extend too far outward to allow the front door to close completely.

V. Disconnect exchanger tube and place inside of C-1. Close both doors, install padlock affix tamper seal and affix the new source ID to the exposure device.

W. Survey all exterior surfaces of the package to assure that the radiation level does not exceed 200mR/hr at the surface or 10mR/hr at one meter (3.3 feet).

X. Complete the Source Transfer/Disposal Record (see attachment 6) and forward it to the RSO.

#### 16.4 RECORDS

Source Transfer/Disposal Records shall be maintained for a minimum of three years after completion.

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## **17.0 EMERGENCY INSTRUCTIONS**

### **17.1 RESPONSIBILITY**

It is the Radiographer's and/or Radiographer's Assistants responsibility to notify the RSO or Asst. RSO of any situation in which they believe an emergency condition exists whether it be in transportation, use and/or storage of radioactive material.

### **17.2 EMERGENCY SITUATION EXAMPLES**

Emergency situations are defined, but not limited, to the following examples:

1. Dosimeter goes off-scale.
2. Radioactive source becomes stuck in the source guide tube.
3. Damage to source material drive mechanisms or source guide tubes preventing the retraction of the source to its properly shielded position.
4. Radiographic exposure device (camera) is dropped or damaged.
5. Radiation survey instrument does not function properly (check backup instruments first).
6. Accident during transportation of source material via company vehicle.

**NOTE 1:** Never leave the scene of an accident, unless you need medical attention- until you are sure of the security of the source material.

**NOTE 2:** In the event of incapacitation during the accident, placard(s), such as, Caution Radioactive Material and Notice signs should be in an appropriate place in the vehicle as to inform local, state and/or civil authorities who are to be contacted.

7. Fire in an area where radiographic exposure devices are stored (temporary or permanent).

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**(EMERGENCY SITUATION EXAMPLES continued)**

8. Lost or stolen source material.
9. Any situation in which it is believed that radiation over exposure to an individual has occurred.
10. Any situation in which it is believed that a radiation exposure has occurred to a film badge or TLD and not to that individual.
11. Possible property damage that has or may occur because of source material.
12. Lost, wet or damaged TLD.
13. Excessive levels of radiation upon receipt of radioactive products.

**17.3 NOTIFICATION**

(In accordance with Radiograph Emergency/Incident Report - see Fig. 17-5).  
One of the following individuals shall be notified as soon as possible by telephone (collect if necessary), Company pager, or Company radio:

1. Hudson Walls, RSO  
Residence: 216-257-2928  
Perry Plant: 216-259-3737 Ext: 6255  
Pager: 216-275-0490
2. Gordon Gayton, Asst. RSO  
Residence: 216-428-7169  
Perry Plant: 216-259-3737 Ext: 6320  
Pager: 216-275-4162

In the event that the above individuals cannot be reached, notify the applicable NRC regional office. The telephone number can be found on the Form NRC-3 (See Figure 9-2).



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**17.4 ASSESSMENT**

The following assessments shall be completed by the radiographer on-site and/or R.S.O. when notified on the incident. Three (3) emergency assessments are included in this section.

<b>TYPE OF EMERGENCY</b>	<b>REFERENCE PARAGRAPH</b>
Receipt Materials (Excessive Radiation Level)	17.4.1
Personnel Overexposure	17.4.1
Exposure Device	17.4.1
Source Out of Guide Tube	17.4.1
Loss of Source on the Jobsite	17.4.1
Other Condition Not Listed Below	17.4.1
Missing or Stolen Source	17.4.2
Plant or Area Fire	17.4.3

1. Assessment guidelines for emergency conditions excluding fires and/or missing or stolen source.
  - A. Determine source is properly shielded.
  - B. The exposure area is properly posted.
  - C. The exposure area is under proper surveillance.
  - D. Personnel are clear of the exposure area.
  - E. Determine if personnel are in danger of receiving further exposure.
  - F. Notify RSO/Asst. RSO and appropriate personnel as deemed necessary by the RSO/Assistant RSO.
  - G. Determine if personnel were injured.
  - H. Seek assistance of personnel that may have had previous radiation safety training.

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- I. When necessary, determine the radiation exposure of all personnel effected. Personnel with off- scale pocket dosimetry are to be immediately removed from the radiation exposure area. The individuals badge (or TLD) shall be immediately sent for processing by expedited delivery.
  - J. Determine the nucleid and S/N of the source and identify the activity (curies) to aid in determining the estimated radiation area boundaries.
  - K. Verify the exact source location, or determine location by triangulation as explained in attachment #1.
  - L. If necessary, re-establish the radiation area boundaries.
  - M. Determine if shielding is available to assist in recovery.
  - N. Determine a method of recovery which will minimize personnel exposure. This shall include a specific recovery procedure to include exposure rates for each step.
  - O. When the emergency has been cancelled proceed with the required post emergency action.
2. Assessment guidelines for missing or stolen sources.
- A. Determine what nucleid and S/N is missing.
  - B. Determine if the exposure device, storage container, or source changer containing the source is missing.
  - C. Rope off the area where the source was last located to protect any evidence.
  - D. Determine the need to clear the work area and notify proper area supervision of the incident.
  - E. Assure area is properly supervised and contact or have the RSO contacted and appraised of the situation.

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**(ASSESSMENT continued)**

- F. Determine what witnesses may be available to assist in location.**
  - G. Determine if evidence exists indicating tampering with the lock.**
  - H. The RSO will determine the necessary post emergency actions required.**
  - I. Do not leave the area unattended until notified by the RSO.**
- 3. Assessment guidelines for plant or area fire.**
- A. In the event that the source is exposed, safely secure and remove it from the danger zone if at all possible.**
  - B. If source cannot be secured and/or removed locate area where source was left.**
  - C. Determine if radiation area can be maintained under surveillance.**
  - D. Assure personnel have been cleared of the radiation area.**
  - E. Notify plant supervision and fire crew of the radiation hazard.**
  - F. Notify or have the RSO notified of the emergency situation.**
  - G. Complete the assessments as required by 17.4.1 after notification of the RSO.**

**17.5 POST EMERGENCY ACTION**

- 1. Personnel with off-scale pocket dosimeter (regardless of suspected cause) are immediately barred from performing radiography or receiving additional occupational radiation exposure. The individual's TLD shall be immediately sent for processing by expedited delivery. The individual may not return to radiographic functions or receive occupational radiation exposure until the TLD results are reported, reviewed and the individual is released for work by the Radiation Safety Officer.**
- 2. The individuals suspected radiation exposure shall be calculated if the cause of the off-scale dosimeter is known and is the result of radiation exposure. Calculation shall be based on reenactment of the occurrence or available data**



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**(POST EMERGENCY ACTION continued)**

provided the information is specific concerning time, distance, shielding, type of by-product material (source), and activity.

3. Equipment that may have been damaged during the incident shall be removed from service until an inspection, maintenance, and calibration (if required) has been performed to the satisfaction of the Radiation Safety Officer.
4. Obtain and implement formal corrective action(s) and action(s) to prevent recurrence of all radiation emergencies.

**17.6 REPORTING**

The Radiation Safety Officer shall report incidents or cause reports to be made regarding incidents that shall be reported to the NRC. Reporting of incidents shall be in compliance with the following subparagraphs. The Radiographer shall be responsible for completion of the Radiographic Incident Report as soon as the incident is under control.

**1. Immediate Reporting**

The following conditions shall require immediate reporting by telephone and telegram, mailgram or facsimile. A written report shall be provided within 30 days.

- A. Exposure  
Whole body - 25 rem or more  
Hands, forearms, feet and ankles - 375 rem or more.
- B. Contamination  
Any release of radioactive material (see Note).
- C. Work Loss  
The loss of one work week or more of the operation of any facility affected.
- D. Damage  
Property damage in excess of \$200,000.

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**(REPORTING continued)**

**E. Receipt Material (Excessive Radiation Levels)**

Also requires notification of final carrier and manufacturer.

**2. Twenty-Four Hour Reporting**

The following conditions shall be reported within 24 hours by telephone, telegram, mailgram or facsimile. A written report shall be provided within 30 days.

**A. Exposure**

Whole body - 5 rem or more

Hands, forearms, feet and ankles - 75 rem or more.

**B. Contamination**

Any release of radioactive material (see Note).

**C. Work Loss**

The loss of one day or more of the operation of any facility affected.

**D. Damage**

Damage of property in excess of \$2000.

**3. Thirty-Day Reporting**

The following conditions shall be reported in writing within 30 days.

**A. Exposure**

Whole body - 1.25 rem or more. Three rem or more when the dose to the whole body when added to the accumulated occupational dose to the whole body does not exceed 5 (N-18) rem, where "N" equals the individuals age in years at their last birthday and the company has determined, documented and filed the individuals accumulated occupational dose.

Hands, forearms, feet and ankles - 18.75 rem.

**B. Contamination**

Any release of radioactive material (see Note).

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**C. Work Loss**

The loss of 4 hours or more in any facility.

**D. Damage**

Damage of property in excess of \$500.

**E. Radiation Levels**

Radiation levels in an unrestricted area exceeding ten (10) times the limit for an unrestricted area.

**NOTE:** The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 5000 times the limits specified for materials in Appendix 5, Table II of 10-CFR-Part 20.

**17.7 RECORDS**

The Radioactive Incident Report and reports to the NRC shall be maintained for a minimum of three years after completion.

**17.8 FIGURES**

The attached figures are graphs and charts to assist an individual in the event a survey need be performed to locate a source.

Figure 17-1 describes the proper method of discovery of a lost source or damaged radiographic device.

Figure 17-2 describes half and tenth value thickness to be used as shielding material.

Figures 17-3 & 17-4 calculate the mr/hr rate at given source strengths, distance and time. These will be helpful in establishing a safe radiation perimeter.



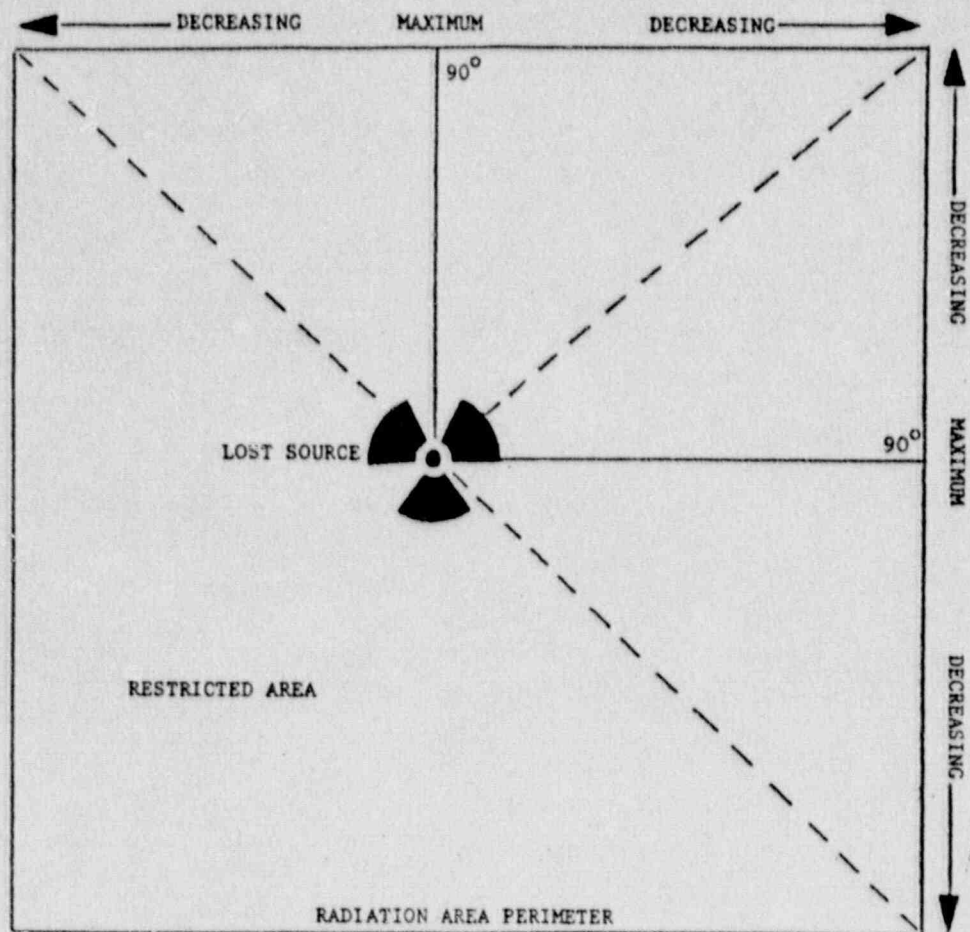
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FIGURE 17-1

ATTACHMENT B

LOCATING A LOST SOURCE USING THE SURVEY METER



1. Survey the area in two straight paths that are  $90^\circ$  to each other.
2. Identify the location of maximum reading on each path.
3. Visually project a line at  $90^\circ$  to each path. The intersection of the projected lines will be the source location. Remember, these paths lead into the high radiation area.

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FIGURE 17-2

ATTACHMENT D

HALF AND TENTH VALUE THICKNESS  
(Inches)

	Iridium 192	Cobalt 60
Lead Half	.19	.49
Tenth	.64	1.62
Steel Half	.53	.87
Tenth	1.80	2.90
Concrete Half	1.90	2.70
Tenth	6.20	9.00
Tungsten Half	.12	.31
Tenth	.40	1.04

Inverse Square Law

$$D = D_0 \left( \frac{r_0}{r} \right)^2$$

r = the distance or radius where you want to calculate the dose rate

r<sub>0</sub> = the distance or radius where you know the dose rate

D = the dose or dose rate you want to calculate

D<sub>0</sub> = the dose or dose rate you know

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**FIGURE 17-3**

**ATTACHMENT D**

**RADIATION INTENSITIES AT VARIOUS SOURCE DISTANCES FROM UNSHIELDED SOURCE**

**Iridium 192**

Exposure Time In Any One Hour	Distance From Perimeter of Restricted Area	mr/hr Level	Exposure Time In Any One Hour	Distance From Perimeter of Restricted Area	mr/hr Level
<u>20 Curies Strength</u>			<u>30 Curies Strength</u>		
60 min.	228 ft.	2 mr/hr	60 min.	279 ft.	2 mr/hr
30 min.	161 ft.	4 mr/hr	30 min.	197 ft.	4 mr/hr
10 min.	93 ft.	12 mr/hr	10 min.	114 ft.	12 mr/hr
5 min.	66 ft.	24 mr/hr	5 min.	81 ft.	24 mr/hr
1 min.	29 ft.	120 mr/hr	1 min.	36 ft.	120 mr/hr
<u>40 Curies Strength</u>			<u>50 Curies Strength</u>		
60 min.	322 ft.	2 mr/hr	60 min.	360 ft.	2 mr/hr
30 min.	228 ft.	4 mr/hr	30 min.	255 ft.	4 mr/hr
10 min.	132 ft.	12 mr/hr	10 min.	147 ft.	12 mr/hr
5 min.	93 ft.	24 mr/hr	5 min.	104 ft.	24 mr/hr
1 min.	42 ft.	120 mr/hr	1 min.	46 ft.	120 mr/hr
<u>60 Curies Strength</u>			<u>70 Curies Strength</u>		
60 min.	395 ft.	2 mr/hr	60 min.	427 ft.	2 mr/hr
30 min.	279 ft.	4 mr/hr	30 min.	302 ft.	4 mr/hr
10 min.	161 ft.	12 mr/hr	10 min.	174 ft.	12 mr/hr
5 min.	114 ft.	24 mr/hr	5 min.	123 ft.	24 mr/hr
1 min.	51 ft.	120 mr/hr	1 min.	55 ft.	120 mr/hr
<u>80 Curies Strength</u>			<u>90 Curies Strength</u>		
60 min.	456 ft.	2 mr/hr	60 min.	484 ft.	2 mr/hr
30 min.	322 ft.	4 mr/hr	30 min.	342 ft.	4 mr/hr
10 min.	186 ft.	12 mr/hr	10 min.	197 ft.	12 mr/hr
5 min.	132 ft.	24 mr/hr	5 min.	140 ft.	24 mr/hr
1 min.	59 ft.	120 mr/hr	1 min.	62 ft.	120 mr/hr
<u>100 Curies Strength</u>			<u>Intensities of Iridium 192</u>		
60 min.	510 ft.	2 mr/hr	5.2 R/hr from 1 curie at 1 foot		
30 min.	360 ft.	4 mr/hr	.48 R/hr from 1 curie at 1 meter		
10 min.	208 ft.	12 mr/hr			
5 min.	147 ft.	24 mr/hr			
1 min.	66 ft.	120 mr/hr			



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**FIGURE 17-4**

**ATTACHMENT D**

**RADIATION INTENSITIES AT VARIOUS SOURCE DISTANCES FROM UNSHIELDED SOURCE**

**Cobalt 60**

Exposure Time In Any One Hour	Distance From Perimeter of Restricted Area	mr/hr Level	Exposure Time In Any One Hour	Distance From Perimeter of Restricted Area	mr/hr Level
<u>5 Curies Strength</u>			<u>10 Curies Strength</u>		
60 min.	187 ft.	2 mr/hr	60 min.	265 ft.	2 mr/hr
30 min.	132 ft.	4 mr/hr	30 min.	187 ft.	4 mr/hr
10 min.	76 ft.	12 mr/hr	10 min.	108 ft.	12 mr/hr
5 min.	54 ft.	24 mr/hr	5 min.	76 ft.	24 mr/hr
1 min.	24 ft.	120 mr/hr	1 min.	34 ft.	120 mr/hr
<u>20 Curies Strength</u>			<u>30 Curies Strength</u>		
60 min.	374 ft.	2 mr/hr	60 min.	458 ft.	2 mr/hr
30 min.	265 ft.	4 mr/hr	30 min.	324 ft.	4 mr/hr
10 min.	153 ft.	12 mr/hr	10 min.	187 ft.	12 mr/hr
5 min.	108 ft.	24 mr/hr	5 min.	132 ft.	24 mr/hr
1 min.	48 ft.	120 mr/hr	1 min.	59 ft.	120 mr/hr
<u>50 Curies Strength</u>			<u>Intensities of Iridium 192</u>		
60 min.	592 ft.	2 mr/hr	14.0 R/hr from 1 curie at 1 foot 1.3 R/hr from 1 curie at 1 meter		
30 min.	418 ft.	4 mr/hr			
10 min.	241 ft.	12 mr/hr			
5 min.	171 ft.	24 mr/hr			
1 min.	76 ft.	120 mr/hr			

**RADIATION INTENSITIES AT VARIOUS DISTANCES FROM UNSHIELDED SOURCE**

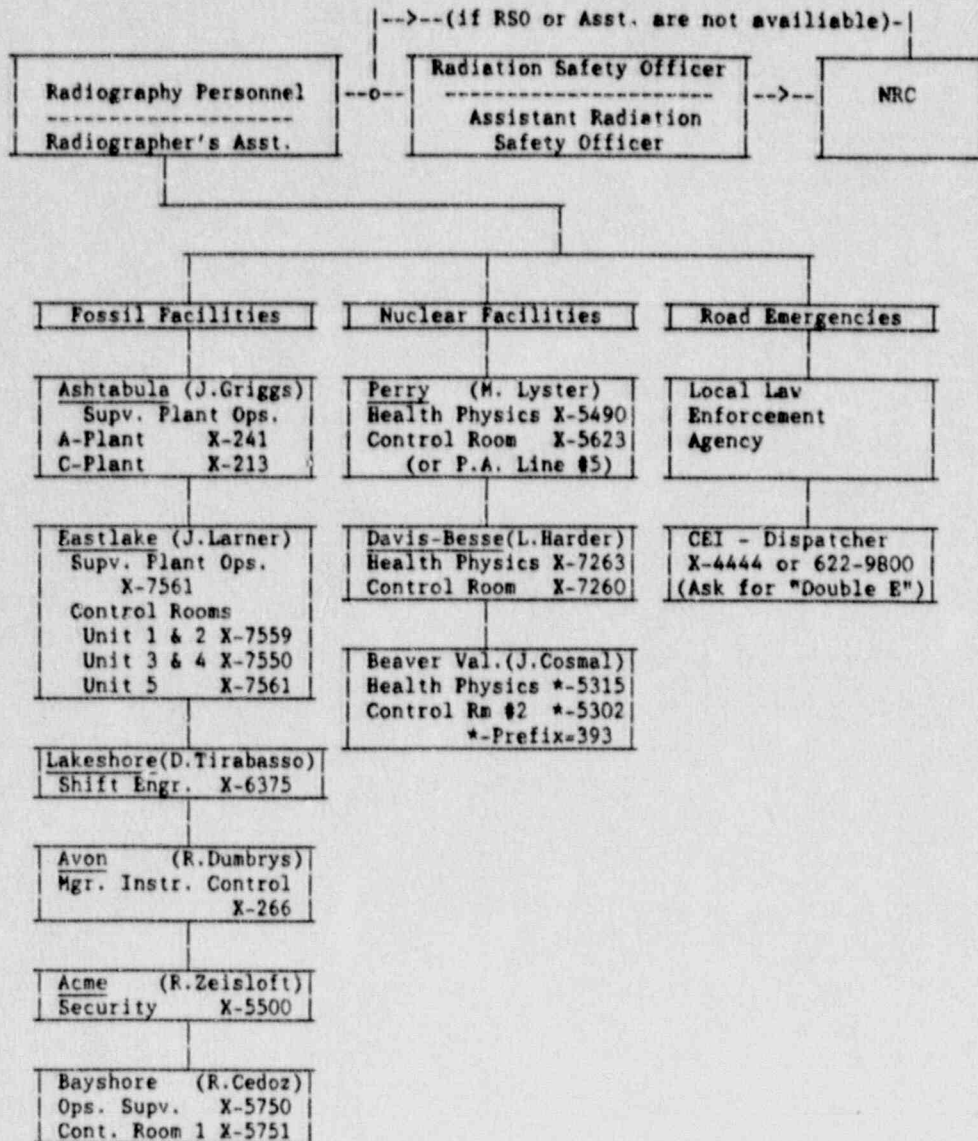
Distance From	Cobalt 60 Milliroentgens Per Hour Per Curie	Iridium 192 Milliroentgens Per Hour Per Curie
1	14,000	5,200
5	560	208
10	140	52
15	62	23
20	35	13
25	22	8
30	15	6

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**FIGURE 17-5**

**RADIOGRAPHIC EMERGENCY / INCIDENT NOTIFICATION CHART**



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## **18.0 ABBREVIATIONS AND DEFINITIONS**

### **18.1 ABBREVIATIONS**

- 1. Asst. RSO - Assistant Radiation Safety Officer**
- 2. CSC - CENTERIOR SERVICES Company**
- 3. mR - millirem**
- 4. NRC - Nuclear Regulatory Commission**
- 5. R - Roentgen**
- 6. Rad - Radiation absorbed dose**
- 7. Rem - Roentgen equivalent man**
- 8. RSO - Radiation Safety Officer**
- 9. TLD - Thermoluminescent Dosimeter**

### **18.2 DEFINITIONS**

- 1. Assistant Radiation Safety Officer (Asst. RSO)**  
An individual appointed by the Radiation Safety Officer to be responsible for the administration of the Industrial Radiography Program.
- 2. Authorized Personnel**  
Personnel qualified as Radiographers and Radiographer's Assistant in accordance with 10 CFR Part 34.
- 3. Byproduct Material**  
Any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material.
- 4. Calibration**  
Check in the accuracy of equipment and instruments against a known standard and correcting as required.
- 5. Camera**  
A radiographic exposure device containing a licensed radioactive isotope for industrial radiography applications (Also see: Radiographic Exposure Device).



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**(DEFINITIONS continued)**

- 6. Collimator**  
A beam shaping device which utilizes shielding material to restrict the direction in which the radiation is emitted.
- 7. Contamination**  
The presence of unwanted radioactive matter, or the "soiling" of objects or material with "radioactive dirt".
- 8. Curie (Ci)**  
The basic unit used to describe the activity in a sample of radioactive material (Also see Units of Radiation).
- 9. Decontamination**  
The removal of radioactive contamination from objects or materials.
- 10. Dose**  
The amount of ionizing radiation energy absorbed per unit mass of irradiated material at a specific location, such as a part of the human body. Measured in rem or rad.
- 11. Dose Rate**  
The radiation dose delivered per unit time and measured, for instance in rems per hour.
- 12. Dosimeter**  
A device that measures radiation dose. It contains an ionization chamber.
- 13. Dosimeter Charger**  
A device used to charge a dosimeter.
- 14. Dosimetry**  
(See: personnel monitoring equipment)
- 15. Emergency Instruction**  
Instructions to be followed by Radiographers and Radiographer's Assistants in the event of an accident, equipment malfunctions or uncontrolled conditions existing while engaging in radiographic activities.

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**(DEFINITIONS continued)**

**16. Exposure**

Exposure to radiation.

**17. Exposure Rate**

Exposure to radiation intensity per unit time.

**18. High Radiation Area**

An area in which there exists radiation originating in whole or in part from licensed material at such levels that a major portion of the body could receive in any one hour a dose in excess of one hundred millirem (100mR).

**19. Operating Instructions**

Instructions to be followed by Radiographers and Radiographer's Assistants in conducting radiographic activities.

**20. Package**

The packaging together with its radioactive contents.

**21. Packaging**

The assembly of shipment components necessary to ensure compliance with the applicable federal regulations.

**22. Personnel Monitoring Equipment**

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, TLD's, etc.). Collectively known as dosimetry.

**23. Physical Survey**

A survey of the location of material and equipment and measurements of the levels of Radiation. (e.g., a survey of all sides of the camera and guide tube to ensure proper storage within the camera).

**24. Radiation**

The propagation of energy through matter or space in the form of waves or particles.

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**(DEFINITIONS continued)**

**25. Radiation Absorbed Dose (RAD)**

The measure of the dose of any ionizing radiation to any specified material in terms of the energy absorbed per unit mass of the material.

**26. Radiation Area**

An area in which there exists radiation originating in whole or in part from licensed material at such levels that a major portion of the body could receive in any one hour a dose in excess of five millirem (5mR), or in any five consecutive days a dose in excess of one hundred millirem (100mR).

**27. Radiation Equivalent Man (REM)**

A measure of the dose of any ionizing radiation to body tissue in terms of its estimated biological effect relative to a dose of one roentgen (R).

**28. Radiation Safety Officer (RSO)**

The representative appointed by the licensee who is responsible for the administration of the Industrial Radiography Program and is the liaison between the licensee and NRC on such matters.

**29. Radiation Survey**

The process of using an instrument (survey meter) to measure the presence of ionizing radiation.

**30. Radioactive**

Atoms which are energetically unstable and decay to a stable condition by emitting radiation are said to be radioactive.

**31. Radiographer**

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 these regulations and the conditions of the license.

**32. Radiographer's Assistant**

Any individual who, under the personal supervision of the Radiographer, uses radiographic exposure devices, sealed sources or related handling tools, or survey instruments in radiography.



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**(DEFINITIONS continued)**

**33. Radiographic Exposure Device**

Any instrument containing a sealed source fastened or contained therein, in which the sealed source or shielding thereof may be moved, or otherwise changed, from a shielded to unshielded position for purposes of making a radiographic exposure. This may also refer to machines which produce ionizing radiation.

**34. Radiography**

The examination of the materials by nondestructive methods utilizing sealed sources of byproduct material and other sources of ionizing radiation.

**35. Radioisotope**

An unstable isotope of an element that decays or disintegrates spontaneously, emitting radiation.

**36. Recharging Dosimeters - same as zeroing.**

**37. Restricted Area**

Any area of access controlled by the Licensee for the purpose of protecting individuals from exposure to radiation and radioactive materials.

**38. Roentgen**

A unit of exposure, in air which is the amount of ionization produced under specified conditions.

**39. Sealed Source**

Any byproduct material that is encased in a capsule designed to prevent leakage or escape of the byproduct material.

**40. Shield**

A layer or mass of material used to reduce the passage of ionizing radiation.

**41. Source**

A radioactive material packaged so as to produce radiation for experimental or industrial use.

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**(DEFINITIONS continued)**

**42. Storage Container**

A device in which sealed sources are transported or stored.

**43. Survey**

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.

**44. Survey Meter**

An instrument that instantly measures the dose rate of exposure or radiation intensity used for monitoring radiation areas.

**45. Thermoluminescent Dosimeter (TLD)**

A device worn by individuals to measure exposure to ionizing radiation.

**46. Time of Storage Survey**

A survey of the exposure device or source changer accomplished at the time of storage to ensure that the Radiation levels do not exceed 2mR/hr at a distance of 18 inches from the exterior of the storage area.

**47. Units of Radiation**

Radioactivity is commonly measured using the following terms:

1 Curie (Ci) =  $3.7 \times 10^{10}$  disintegrations per second (dps) or  $2.22 \times 10^{12}$  dpm.

1 millicurie (mCi) = 0.001 Curie =  $3.7 \times 10^7$  dps or  $2.22 \times 10^9$  dpm.

1 microcurie (uCi) = 0.000001 Curie =  $3.7 \times 10^4$  dps  
or  $2.22 \times 10^6$  dpm.

**48. Zeroing Dosimeters - Placing dosimeters on a dosimeter charger and adjusting so the reading is between zero and 10 MR.**

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**19.0 Forms**

**19.1 FORMS**

The below described forms are exhibited in the Attachments.

<b>ATTACHMENT NO.</b>	<b>FORM TITLE</b>	<b>REV.</b>
Attach. 1	Quarterly Inventory/Periodic Maintenance Report	0
Attach. 1a	Quarterly Inventory Log	0
Attach. 2	Dosimeter Calibration Log	0
Attach. 3	Radiographic Operation Report	0
Attach. 4	Radiographic Incident Report	0
Attach. 5	Radioactive Material Receipt Inspection Report	0
Attach. 6	Source Transfer/Disposal Record	0
Attach. 7	Radioactive Material Shipping Record	0
Attach. 8	Leak Test Data Sheet	0
Attach. 9	Training Record for Radiography Personnel	0
Attach. 10	Annual Training Review	0
Attach. 11	Qualification Basis for Radiography Personnel	0
Attach. 12	Performance Review Checklist	0



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(FORMS continued)

Attach. 13	Industrial Radiography Program Update	0
Attach. 14	Industrial Radiography Program Revision Review	0
Attach. 15	"Notice"	0
Attach. 16	Weekly Dosimeter Log	0
Attach. 17	Leak Test Sticker	0
Attach. 18	Section 206 of the Energy Reorganization Act of 1974	0
Attach. 19	Source Utilization Log	0

## 19.2 RECORD RETENTION

The record retention requirements are delineated in the specific sections as generated within this manual.











**Prior To Use (Daily) Inspections:**

[OK]

1. Inspect camera for damage to lock, fittings, fasteners and labels ---- [ ]
2. Inspect control cable and guide tubes for cuts, breaks, broken or loose fittings ----- [ ]
3. Inspect crank for damage or loose hardware ----- [ ]
4. Check operation of cable connections ----- [ ]
5. Check operation of control for freedom of source movement ----- [ ]
6. Survey exposure device surface: Results = \_\_\_\_\_ mR/hr ----- [ ]
7. Warning signs placed and radiation boundaries established ----- [ ]

EXPOSURE

Location: \_\_\_\_\_ mR/hr  
 @ \_\_\_\_\_ feet

Time per exposure: \_\_\_\_\_

No. of exposures: \_\_\_\_\_ @ \_\_\_\_\_ mR/hr  
 @ \_\_\_\_\_ feet | --o-- | @ \_\_\_\_\_ mR/hr  
 | |

Final Physical Survey Results= \_\_\_\_\_ mR/hr @ \_\_\_\_\_ feet

EXPOSURE

Location: \_\_\_\_\_ mR/hr  
 @ \_\_\_\_\_ feet

Time per exposure: \_\_\_\_\_

No. of exposures: \_\_\_\_\_ @ \_\_\_\_\_ mR/hr  
 @ \_\_\_\_\_ feet | --o-- | @ \_\_\_\_\_ mR/hr  
 | |

Final Physical Survey Results= \_\_\_\_\_ mR/hr @ \_\_\_\_\_ feet

Source Storage: [ ] - In Vehicle; [ ] - In Storage Area; [ ] - Transported  
 (Transported to - \_\_\_\_\_)

Time of Storage Survey= \_\_\_\_\_ mR/hr @ 18 inches (Post and secure area)

Remarks- \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

The below signed individual(s) verify that the above information is accurate and has been completed in accordance with CSC's Industrial Radiography License Procedures and applicable Federal Regulations.

Signed: \_\_\_\_\_ Title: \_\_\_\_\_

Signed: \_\_\_\_\_ Title: \_\_\_\_\_

Reviewed By: \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_



RADIOGRAPHIC INCIDENT REPORT

Rev. 0

Page 1 of \_\_\_

Radiographer: \_\_\_\_\_ Date \_\_\_ / \_\_\_ / \_\_\_ Time: \_\_\_\_\_

Work Location: \_\_\_\_\_

Who notified: (RSO) (Asst.RSO) Date \_\_\_ / \_\_\_ / \_\_\_ Time: \_\_\_\_\_

Were radiographic operations suspended immediately ?-----[yes] [no]

Fill in the applicable incident block below and explain all pertinent info. in the details section.

- Lost, Wet or Damaged TLD

TLD ID No. - \_\_\_\_\_

Assigned To: \_\_\_\_\_

- TLD Possible Exposure to Radiation

TLD ID No. - \_\_\_\_\_

Assigned To: \_\_\_\_\_

Where was TLD located when it was believed to be expose to radiation ?

\_\_\_\_\_  
\_\_\_\_\_

How much radiation (estimated) did the Film Badge/TLD receive ?  
under 25mR-[ ] 25 to 75mR-[ ] 75 to 150mR-[ ] 150 to 250mR-[ ]  
250 to 500mR-[ ] above 500mR-[ ] unknown-[ ]

- Possible Overexposure of Radiation to an Individual

Individual(s) involved: \_\_\_\_\_

TLD ID No. - \_\_\_\_\_

Dosimeter Off-Scale ? - (YES) (NO) When Noticed (Time): \_\_\_\_\_

How far away from the source was the individual ? - \_\_\_\_\_

For how long ? \_\_\_\_\_

Exposure Device - \_\_\_\_\_ Serial No. - \_\_\_\_\_

Source: (Ir192) (Co60) Serial No. - \_\_\_\_\_ Curies - \_\_\_\_\_

Survey Meter ID No. - \_\_\_\_\_ Cal. Due - \_\_\_ / \_\_\_ / \_\_\_



(Industrial Radiography Program - Attachment #5)

RADIOACTIVE MATERIAL RECEIPT INSPECTION REPORT

Rev. 0

Date Received : \_\_\_\_ / \_\_\_\_ / \_\_\_\_ Material : Ir 192-[ ] Co 60-[ ] Curies \_\_\_\_

Supplier/Mfr.- \_\_\_\_\_ Purchase Order : \_\_\_\_\_

Model No.- \_\_\_\_\_ S/N- \_\_\_\_\_ Leak Tested- \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Container ID.- \_\_\_\_\_

Inspect for damage : None found-[ ] Yes-[ ] (explain in remarks)

Final Delivery Carrier : \_\_\_\_\_

Location Received : \_\_\_\_\_

Physical Survey

Shipping Container: \_\_\_\_\_ mR/hr @ surface; \_\_\_\_\_ mR/hr @ 3 feet

Survey Meter ID. - \_\_\_\_\_ Cal. Due \_\_\_\_ / \_\_\_\_ / \_\_\_\_

[ ] - Transferred to Exposure Device (See Source Transfer/Disposal Record)

[ ] - Source recieved in an Exposure Device

Time of Storage Survey

Storage Location - \_\_\_\_\_

Survey Results : \_\_\_\_\_ mR/hr @ 18 inches from the surface.

Storage area secured and posted correctly ? \_\_\_\_\_

Remarks : \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Performed By : \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Performed By : \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Reviewed By : \_\_\_\_\_ Date: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

(RSO) (Asst. RSO)



(Industrial Radiography Program - Attachment #6)

SOURCE TRANSFER/DISPOSAL RECORD

Rev. 0

Radioactive Material (1): Ir 192 - [ ] or Co 60 - [ ] : Curies- \_\_\_\_\_

Serial No. - \_\_\_\_\_ Leak Tested: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Transferred From : Exposure Device Mfr/Model: \_\_\_\_\_

Serial No: \_\_\_\_\_

Transferred To : Source Changer Mfr/Model: \_\_\_\_\_

Serial No: \_\_\_\_\_

Radioactive Material (2): Ir 192 - [ ] or Co 60 - [ ] : Curies- \_\_\_\_\_

Serial No. - \_\_\_\_\_ Leak Tested: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Transferred From : Source Changer Mfr/Model: \_\_\_\_\_

Serial No: \_\_\_\_\_

Transferred To : Exposure Device Mfr/Model: \_\_\_\_\_

Serial No: \_\_\_\_\_

Physical Survey Following Transfer

Exposure Device : Surface= \_\_\_\_\_ mR/hr ; Three feet= \_\_\_\_\_ mR/hr

Source Changer : Surface= \_\_\_\_\_ mR/hr ; Three feet= \_\_\_\_\_ mR/hr

Reason for Transfer: Source Disposal - [ ] Source Exchange - [ ]

Remarks- \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Performed By : \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Performed By : \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Reviewed By : \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_

(Industrial Radiography Program - Attachment #7)

RADIOACTIVE MATERIAL SHIPPING RECORD

Rev. 0

Ship To : \_\_\_\_\_

Carrier - \_\_\_\_\_

Weight - \_\_\_\_\_ Date Shipped \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Radioactive Material

- Proper Shipping Name:  - RADIOACTIVE MATERIAL, Special Form N.O.S, UN 2974  
 - RADIOACTIVE MATERIAL, Articles Manufactured from Depleted Uranium, UN 2909  
 - RADIOACTIVE MATERIAL, L.S.A., N.O.S., UN 2912  
 - RADIOACTIVE MATERIAL, Empty Package, UN 2908

Radionuclide	Form	Curies	Serial No.	IAEA Certificate No.

TYPE B SHIPPING CONTAINER

Mfr/Model No.	Serial No.	Cert. of Compliance No.

Depleted U238, Normal form \_\_\_\_\_ lb. @ .15mci/lb. = \_\_\_\_\_ mci

Physical Survey Results

Shipping Container: \_\_\_\_\_ mR/hr @ surface ; \_\_\_\_\_ mR/hr @ 3.3 ft.

"Radioactive" Label:  - White I;  - Yellow II;  - Yellow III (\*)  
(\*- Placards required)

Transportation Index assigned: \_\_\_\_\_ (N/A to Radioactive White I)

Survey meter ID. No. - \_\_\_\_\_ Cal. Due - \_\_\_\_ / \_\_\_\_ / \_\_\_\_

SHIPPERS CERTIFICATION

This is to certify that the above named materials have been properly labeled, marked, described, classified, packaged, and are in proper condition for transport according to the applicable regulations of the Department of Transportation.

TRANSPORTATION BY AIR

This shipment is within the limitations prescribed for Cargo-Only aircraft.

Signed: \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_

(Industrial Radiography Program - Attachment #8)

LEAK TEST DATA SHEET

Rev. 0

Radioactive Material: Ir 192--[ ] Co 60--[ ] Curies - \_\_\_\_\_

Source Serial No. - \_\_\_\_\_ Last Leak Tested - \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Exposure Device: Mfr/Model No. - \_\_\_\_\_

Serial No. - \_\_\_\_\_

Physical Survey Results

Exposure Device: Surface= \_\_\_\_\_ mR/hr; Three Feet= \_\_\_\_\_ mR/hr

Survey Meter ID No. - \_\_\_\_\_ Cal. Due - \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Test Sample Radiation Level: Less than 2mR/hr--[ ] Greater than 2mR/hr--[ ]

(Note: If the test sample is greater than 2mR/hr, notify the RSO immediately)

Time of Storage Survey

Storage Location - \_\_\_\_\_

Survey Results : \_\_\_\_\_ mR/hr @ 18 inches from the surface.

Remarks - \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Performed By: \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Performed By: \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_



LEAK TEST DATA SHEET (Cont.)

\*\*\*\*\*

Sample Evaluation

SCN/Location	Count Time (mins)	Gross cpm	BKG cpm	Net cpm	Eff.	dpm			0.005	
									Sat	Unsat
1										
2										
3										
4										
5										

Note: Acceptance criteria for leak tests shall be less than 0.005 microcuries of removable contamination. This corresponds to 11,100 dpm. If any sample is unacceptable, notify the Industrial Radiography RSO or Asst. RSO immediately at extension 6255. Forward the results upon completion to the Nondestructive Examination Unit (TS-17).

Counter MPL No. - \_\_\_\_\_ Cal. Due - \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Counter MPL No. - \_\_\_\_\_ Cal. Due - \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Remarks - \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Counted By: \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_

\*\*\*\*\*

Reviewed By: \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_

(Industrial Radiography Program - Attachment #9)

TRAINING RECORD FOR RADIOGRAPHY PERSONNEL

Rev. 0

Trainee: \_\_\_\_\_ Position: \_\_\_\_\_

Date(s) of Training : \_\_\_\_\_ Total Hours: \_\_\_\_\_

Subject: \_\_\_\_\_

Objective: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Training Materials: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Evaluation: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Training Conducted By:

Organization \_\_\_\_\_

Title \_\_\_\_\_

Signature \_\_\_\_\_

Trainee: \_\_\_\_\_

Reviewed By : \_\_\_\_\_

(RSO) (Asst. RSO)

(Industrial Radiography Program - Attachment #10)

ANNUAL TRAINING REVIEW

Rev. 0

Name: \_\_\_\_\_ SSN: \_\_\_\_\_ - -

Dates of Training: \_\_\_\_\_

<u>Topics Covered</u>	<u>YES</u>	<u>N/A</u>
Revisions to the Industrial Radiography Program -----	[ ]	[ ]

Items Reviewed: \_\_\_\_\_  
\_\_\_\_\_

Revisions to applicable Federal Regulations-----	[ ]	[ ]
--	-----	-----

Items Reviewed: \_\_\_\_\_  
\_\_\_\_\_

Review of Audit Findings-----	[ ]	[ ]
-------------------------------	-----	-----

Items Reviewed: \_\_\_\_\_  
\_\_\_\_\_

Review of Radiation Incidents-----	[ ]	[ ]
------------------------------------	-----	-----

Items Reviewed: \_\_\_\_\_  
\_\_\_\_\_

Other Items Reviewed: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Trainee: \_\_\_\_\_ Date / /

Trainer: \_\_\_\_\_ Date / /

Reviewed By: \_\_\_\_\_ Date / /

(RSO) (Asst. RSO)



QUALIFICATION BASIS FOR RADIOGRAPHY PERSONNEL

Rev. 0

Name: \_\_\_\_\_ SSN: \_\_\_\_\_ - \_\_\_\_\_ - \_\_\_\_\_

PRIOR TRAINING

Type: \_\_\_\_\_

Where: \_\_\_\_\_ When: \_\_\_\_\_ Hours: \_\_\_\_\_

Type: \_\_\_\_\_

Where: \_\_\_\_\_ When: \_\_\_\_\_ Hours: \_\_\_\_\_

Type: \_\_\_\_\_

Where: \_\_\_\_\_ When: \_\_\_\_\_ Hours: \_\_\_\_\_

Type: \_\_\_\_\_

Where: \_\_\_\_\_ When: \_\_\_\_\_ Hours: \_\_\_\_\_

Past Experience

Employer: \_\_\_\_\_

Where: \_\_\_\_\_ When: \_\_\_\_\_

Qualifications: \_\_\_\_\_

Employer: \_\_\_\_\_

Where: \_\_\_\_\_ When: \_\_\_\_\_

Qualifications: \_\_\_\_\_

Employer: \_\_\_\_\_

Where: \_\_\_\_\_ When: \_\_\_\_\_

Qualifications: \_\_\_\_\_

Name: \_\_\_\_\_

Has the above individual: YES N/A

Received the required training on;

- The Characteristics of Radiation and Radiation Safety -----[ ] [ ]
- The Industrial Radiography Program -----[ ] [ ]
- The Emergency Instructions -----[ ] [ ]
- Transportation of Sources and Equipment Operation -----[ ] [ ]
- Applicable Federal Regulations -----[ ] [ ]

Demonstrated adequate skill, knowledge and judgment in;

- Performing Industrial Radiography -----[ ] [ ]
- Performing Source Changes -----[ ] [ ]
- Performing Leak Tests and Wipe Tests -----[ ] [ ]
- Passed the required written examination -----[ ] [ ]

Test Score: \_\_\_\_\_ %

---

I have reviewed the applicable training records and evaluated the individual identified above. I consider him/her qualified as a (Radiographer) or (Radiographer's Assistant) and additionally qualified to perform:

- N/A
- Leak/Wipe Tests
- Source Changes

Limitations (if any): \_\_\_\_\_

Effective Date of Qualification: \_\_\_\_\_

Evaluated By: \_\_\_\_\_ Title: \_\_\_\_\_

Reviewed By: \_\_\_\_\_ Title: \_\_\_\_\_

(Industrial Radiography Program - Attachment #12)

PERFORMANCE REVIEW CHECKLIST

Rev. 0

Date      /      /     

Performance Review of: \_\_\_\_\_  
(Radiographer) (Radiographer's Assistant)

Radiographic Location - \_\_\_\_\_

- |   | <u>Sat</u> | <u>UnSat</u> | <u>N/A</u> |
|---|------------|--------------|------------|
| 1. Were all applicable prior to use (daily) inspections properly performed-----                                       | [ ]        | [ ]          | [ ]        |
| 2. Did the individual possess a copy of the Radiation Safety Manual-----  | [ ]        | [ ]          | [ ]        |
| 3. Was the individual wearing the proper Film badge/TLD and Dosimeter-----  | [ ]        | [ ]          | [ ]        |
| 4. Were all other individuals working within the restricted area wearing the proper Film badge/TLD and Dosimeter----- | [ ]        | [ ]          | [ ]        |
| 5. Was the high radiation area properly posted-----   | [ ]        | [ ]          | [ ]        |
| 6. Was the radiation boundary properly established and posted--   | [ ]        | [ ]          | [ ]        |
| 7. Was an operable and calibrated survey meter utilized-----  | [ ]        | [ ]          | [ ]        |
| 8. Had the source been leak tested within the previous 6 mo.'s--  | [ ]        | [ ]          | [ ]        |
| 9. Had the Quarterly Inventory / Maintenance been performed within the previous 90 days-----                          | [ ]        | [ ]          | [ ]        |
| 10. Was the restricted area properly controlled to prevent unauthorized entry-----                                    | [ ]        | [ ]          | [ ]        |
| 11. Did the individual have sufficient knowledge of operating practices and safety rules-----                         | [ ]        | [ ]          | [ ]        |
| 12. Did the individual lock the exposure device and properly survey the camera following each exposure-----           | [ ]        | [ ]          | [ ]        |
| 13. Was the source properly stored, locked and the Time of Storage survey performed-----                              | [ ]        | [ ]          | [ ]        |
| 14. Was the storage area properly posted-----   | [ ]        | [ ]          | [ ]        |



PERFORMANCE REVIEW CHECKLIST (Cont.)

Remarks - \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Performed By: \_\_\_\_\_

\*\*\*\*\*

The (Radiographer) (Radiographer's Asst.) has demonstrated an (adequate) (inadequate) understanding of the Radiation Safety Manual, operating practices, safety rules and regulations.

Recommended Training - \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Evaluated By: \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_  
(RSO) (Asst. RSO)

\*\*\*\*\*

I have read and understand the contents of this performance review.

Signed: \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_

\*\*\*\*\*

cc: Director; Corporate Health Physicist; RSO; Asst. RSO; Individual's Training File; Performance Review File

(Industrial Radiography Program - Attachment #13)

INDUSTRIAL RADIOGRAPHY PROGRAM UPDATE

Rev. 0

To: \_\_\_\_\_

From: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Control No.: \_\_\_\_\_

Phone: \_\_\_\_\_

INSTRUCTIONS

Within 3 working days of receipt, please insert and/or remove the below listed items. Attach the removed documents to this transmittal and return. Please sign to acknowledge receipt of the item(s) listed.

It is the responsibility of the Assignee to personally sign this transmittal acknowledging receipt of the material.

Effective Date of: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

INSERT

REMOVE & RETURN

I hereby attest that this manual is current to the date of this form.

Signed: \_\_\_\_\_ / /

INDUSTRIAL RADIOGRAPHY PROGRAM REVISION REVIEW

Rev. 0

To: \_\_\_\_\_ Mail Zone: \_\_\_\_\_

From: \_\_\_\_\_ Mail Zone: \_\_\_\_\_

Please review the attached proposed revision and return by \_\_\_\_ / \_\_\_\_ / \_\_\_\_.

Section No.- \_\_\_\_\_ Revision- \_\_\_\_\_ Recommended Effective Date- \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Title- \_\_\_\_\_

Reason for Revision:

Audit finding/concern--[ ] Regulatory change--[ ] Organization change--[ ]

Program improvement--[ ] Change in an interfacing section--[ ]

Other--[ ] (specify) \_\_\_\_\_

Comments

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Recommendation

- [ ]---Approval - No comments
- [ ]---Approval - Comments are minor
- [ ]---Revision - Comments are major

Reviewed By: \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_



\*\*\*\*\*  
**NOTICE**  
**IN CASE OF AN EMERGENCY OR ACCIDENT INVOLVING**  
**THIS VEHICLE OR RADIOACTIVE MATERIAL STORAGE AREA**  
\*\*\*\*\*

**NOTIFY:**

CENTERIOR SERVICE COMPANY  
NONDESTRUCTIVE EXAMINATION SECTION  
PERRY NUCLEAR POWER PLANT  
10 CENTER RD.  
PERRY, OHIO 44081

---

Call: 216-259-3737  
216-622-9800  
216-951-5322

Ask for Perry extension 6255, 6257 or 6320

**Evenings, Weekends or Holidays Call:**

Hudson Walls (RSO) - 216-257-2928

or

Gordon Gayton (A.RSO) - 216-428-7169

(CALL ANY OF THE ABOVE NUMBERS COLLECT IF NECESSARY)

\*\*\*\*\*  
The following documents are available for review  
at the above listed address or the mobile laboratory.

- \* 10 CFR Part(s) 19, 20, 21, 34, 71
  - \* Section 206 of the Energy Reorganization Act of 1974
  - \* CSC - Industrial Radiography Program
  - \* USNRC License
- \*\*\*\*\*

(Industrial Radiography Program - Attachment #16)

WEEKLY DOSIMETER LOG  
REV. 0

FOR:

SUNDAY / / [ ]- N/A [ ]- Utilized at: \_\_\_\_\_

TLD No.	Dosimeter ID.	Reading @ Start	Reading @ End

Possible radiation dose received from (check all that apply):  
[ ]- X-Ray Radiography [ ]- Source Radiography [ ]- Nuclear Plant (RCA)

MONDAY / / [ ]- N/A [ ]- Utilized at: \_\_\_\_\_

TLD No.	Dosimeter ID.	Reading @ Start	Reading @ End

Possible radiation dose received from (check all that apply):  
[ ]- X-Ray Radiography [ ]- Source Radiography [ ]- Nuclear Plant (RCA)

TUESDAY / / [ ]- N/A [ ]- Utilized at: \_\_\_\_\_

TLD No.	Dosimeter ID.	Reading @ Start	Reading @ End

Possible radiation dose received from (check all that apply):  
[ ]- X-Ray Radiography [ ]- Source Radiography [ ]- Nuclear Plant (RCA)

WEDNESDAY / / [ ]- N/A [ ]- Utilized at: \_\_\_\_\_

TLD No.	Dosimeter ID.	Reading @ Start	Reading @ End

Possible radiation dose received from (check all that apply):  
[ ]- X-Ray Radiography [ ]- Source Radiography [ ]- Nuclear Plant (RCA)

THURSDAY / / [ ]- N/A [ ]- Utilized at: \_\_\_\_\_

TLD No.	Dosimeter ID.	Reading @ Start	Reading @ End

Possible radiation dose received from (check all that apply):  
[ ]- X-Ray Radiography [ ]- Source Radiography [ ]- Nuclear Plant (RCA)

FRIDAY / / [ ]- N/A [ ]- Utilized at: \_\_\_\_\_

TLD No.	Dosimeter ID.	Reading @ Start	Reading @ End

Possible radiation dose received from (check all that apply):  
[ ]- X-Ray Radiography [ ]- Source Radiography [ ]- Nuclear Plant (RCA)

SATURDAY / / [ ]- N/A [ ]- Utilized at: \_\_\_\_\_

TLD No.	Dosimeter ID.	Reading @ Start	Reading @ End

Possible radiation dose received from (check all that apply):  
[ ]- X-Ray Radiography [ ]- Source Radiography [ ]- Nuclear Plant (RCA)

**LEAK TEST**

The Source contained within this Exposure Device was  
Leak Tested on \_\_\_/\_\_\_/\_\_\_ and found to have less than  
0.005 microcuries of removable contamination. This  
Source is due to be Leak Tested prior to \_\_\_/\_\_\_/\_\_\_.



Section 206 of Public Law 93-438, the Energy Reorganization Act of 1974

"NONCOMPLIANCE

Sec. 206. (a) Any individual director, or responsible officer of a firm constructing, owning, operating, or supplying the components of any facility or activity which is licensed or otherwise regulated pursuant to the Atomic Energy Act of 1954, as amended, or pursuant to this Act, who obtains information reasonably indicating that such facility or activity or basic components supplied to such facility or activity -

(1) Fails to comply with the Atomic Energy Act of 1954, as amended, or any applicable rule, regulation, order, or license of the Commission regulating to substantial safety hazards, or

(2) Contains a defect which could create a substantial safety hazard, as defined by regulations which the Commission shall promulgate, shall immediately notify the Commission of such failure to comply, or of such defect, unless such person has actual knowledge that the Commission has been adequately informed of such defect or failure to comply.

(b) Any person who knowingly and consciously fails to provide the notice required by subsection (a) of this section shall be subject to a civil penalty in an amount equal to the amount provided by section 234 of the Atomic Energy Act of 1954, as amended.

(c) The requirements of this section shall be prominently posted on the premises of any facility licensed or otherwise regulated pursuant to the Atomic Energy Act of 1954, as amended.

(d) The Commission is authorized to conduct such reasonable inspection and other enforcement activity as needed to insure compliance with the provisions of this section."



## **Industrial Radiography Program**

### **Appendix A - Applicable Federal Regulations**

The below listed Federal Regulations are contained in this appendix:

- 10 CFR Part 19 - Notices, Instructions, and Reports to Workers; Inspections
- 10 CFR Part 20 - Standards for Protection Against Radiation
- 10 CFR Part 21 - Reporting of Defects and Noncompliance
- 10 CFR Part 34 - Licenses for Radiography and Radiation Safety Requirements for Radiographic Operations
- 10 CFR Part 71 - Packaging and Transportation of Radioactive Material



UNITED STATES NUCLEAR REGULATORY COMMISSION  
RULES and REGULATIONS

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

§ 19.1

§ 19.12

**PART  
19**

**NOTICES, INSTRUCTIONS, AND REPORTS TO WORKERS;  
INSPECTIONS**

- 19.1 Purpose.
- 19.2 Scope.
- 19.3 Definitions.
- 19.4 Interpretations.
- 19.5 Communications.
- 19.6 Information collection requirements: OMB approval.
- 19.11 Posting of notices to workers.
- 19.12 Instructions to workers.
- 19.13 Notifications and reports to individuals.
- 19.14 Presence of representatives of licensees and workers during inspections.
- 19.15 Consultation with workers during inspections.
- 19.16 Requests by workers for inspections.
- 19.17 Inspections not warranted: Informal review.
- 19.30 Violations.
- 19.31 Application for exemptions.
- 19.32 Discrimination prohibited.

Authority: Secs. 51, 63, 67, 103, 104, 161, 186, 68 Stat. 930, 933, 935, 936, 937, 946, 955, as amended; sec. 204, 63 Stat. 644, as amended (42 U.S.C. 2073, 2080, 2111, 2133, 2134, 2201, 2236, 2282); sec. 201, 68 Stat. 1242, as amended by Pub. L. 94-79, 69 Stat. 413 (42 U.S.C. 5841); Pub. L. 95-601, sec. 10, 62 Stat. 2851 (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. 161c, 68 Stat. 950, as amended (42 U.S.C. 2201(c)).

§ 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.

§ 19.2 Scope.

The regulations in this part apply 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.

§ 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.

(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.

(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.

§ 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.

§ 19.6 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.

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

§ 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.

(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.

(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

## PART 19 • NOTICES, INSTRUCTIONS, AND REPORTS TO WORKERS; INSPECTIONS

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 § 20.403 or § 20.409 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.

(a) 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.

#### § 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 licensee, 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 provi-

sions 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-



## PART 19 • NOTICES, INSTRUCTIONS, AND REPORTS TO WORKERS; INSPECTIONS

ment 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).

**§ 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.

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 55, 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.

**§ 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.

**§ 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.



UNITED STATES NUCLEAR REGULATORY COMMISSION

RULES and REGULATIONS

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

§ 20.1

**PART  
20**

STANDARDS FOR PROTECTION AGAINST RADIATION

§ 20.3(a)

**PART 20—STANDARDS FOR PROTECTION AGAINST RADIATION**

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Authority: Secs. 83, 85, 86, 87, 103, 104, 161, 68 Stat. 630, 633, 634, 636, 637, 646, as amended; (42 U.S.C. 2073, 2080, 2086, 2111, 2133, 2134, 2201); sec. 201, as amended, 208, 209, Pub. L. 83-438, 68 Stat. 1242, 1244, 1246, Pub. L. 94-78, 89 Stat. 413 (42 U.S.C. 2041, 2042, 2046).

For the purposes of sec. 223, 68 Stat. 664, 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 20.308 are issued under sec. 181b, 68 Stat. 644, as amended; (42 U.S.C. 2201(b)); and §§ 20.102, 20.103(e), 20.401-20.407, 20.608(b) and 20.609 are issued under sec. 181c, 68 Stat. 650, as amended; (42 U.S.C. 2201(c)).

GENERAL PROVISIONS

§ 20.1 Purpose.

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

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

(c) In accordance with recommendations of the Federal Radiation Council, approved by the President, persons engaged in activities under licenses issued by the Nuclear Regulatory Commission pursuant to the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974

should, in addition to complying with the requirements set forth in this part, make every reasonable effort to maintain radiation exposures, and releases of radioactive materials in effluents to unrestricted areas, as low as is reasonably achievable. The term "as low as is reasonably achievable" means as low as is reasonably achievable taking into account the state of technology, and the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to the utilization of atomic energy in the public interest.

§ 20.2 Scope.

The regulations in this part apply to all persons who receive, possess, use, or transfer material licensed pursuant to the regulations in Parts 30 through 35, 40, 60, 61, 70, 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.

§ 20.3

§ 20.3 Definitions.

(a) As used in this part:

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

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

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

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

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(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;

(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;

(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.

(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.

(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;

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

(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 residential quarters, although a separate room or rooms in a residential building may be set apart as a restricted area;

(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.

(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;

(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.

(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 Act (Pub. L. 95-91, 91 Stat. 565 at 577-578, 42 U.S.C. 7151).

(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.

(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, is the quantity of radiation absorbed, per 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.

(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 upon the conditions of irradiation. For the purpose of the regulations in this part, any of the following is considered to 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;



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(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

Table with 3 columns: Neutron energy (Mev), Number of neutrons per square centimeter equivalent to a dose of 1 rem (neutrons/cm²), Average flux to deliver 100 mrem in 40 hours (neutrons/cm² sec).

(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 x 10¹⁰ disintegrations per second (dps) = 2.2 x 10¹¹ 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 x 10⁷ dps.
(2) One microcurie (µCi) = 0.000001 curie = 3.7 x 10⁴ 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

Table with 2 columns: Description of body part, Rems per calendar quarter.

(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:



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(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 terms for calendar quarters prior to Jan 1, 1961	Column 2— Assumed exposure in terms for calendar quarters beginning on or after Jan 1, 1961
Whole body		
gonads		
active organs		
head and trunk		
lens of eye	3%	1%

(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.<sup>1</sup> 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<sup>2</sup> 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<sup>3</sup> 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 I, 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:

<sup>1</sup> Since the concentration specified for uranium 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.

<sup>2</sup> 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).

<sup>3</sup> Multiply the concentration values specified in Appendix B, Table I, Column 1, by  $6.3 \times 10^4$  ml to obtain the quarterly quantity limit. Multiply the concentration value specified in Appendix B, Table I, Column 1, by  $2.5 \times 10^4$  ml to obtain the annual quantity limit for Rn-222.

<sup>4</sup> 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.

<sup>5</sup> 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.



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

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

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

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

(d) Unless otherwise authorized by the Commission, the licensee shall not assign protection factors in excess of

those specified in Appendix A of this part in selecting and using respiratory protective equipment. The Commission may authorize a licensee to use higher protection factors on receipt of an application (1) describing the situation for which a need exists for higher protection factors, and (2) demonstrating that the respiratory protective equipment will provide these higher protection factors under the proposed conditions of use.

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

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

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

#### § 20.104 Exposure of minors.

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

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

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

#### § 20.105 Permissible levels of radiation in unrestricted areas.

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

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

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

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

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

#### § 20.106 Radioactivity in effluents to unrestricted areas.

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



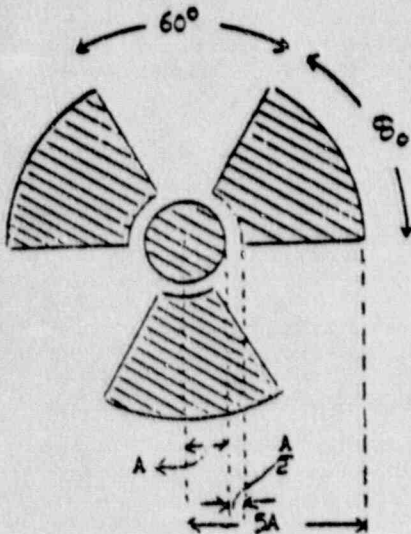
**PART 20 • STANDARDS FOR PROTECTION AGAINST RADIATION**

**§ 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.



(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**

**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**

**HIGH RADIATION AREA**

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.

(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.

(6) Each area in which there may exist radiation levels in excess of 500 rems in one hour at one meter from a sealed radioactive source<sup>1</sup> that is used to irradiate materials shall:

(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.

(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-

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

<sup>2</sup>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.

(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 (pH) 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 recon-

centrations 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.



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prise permanent 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 100 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 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 repairs 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

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:

'Or "Danger".

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

CAUTION

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

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 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 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.



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43 FR 22171  
 (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.

20.204 Same exceptions.  
 Notwithstanding the provisions of § 20.203,

25 FR 10204  
 (a) A room or other 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 5033  
 (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 by-product 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.

26 FR 10916  
 (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.

26 FR 5033  
 (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.

<sup>1</sup> 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

(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.

(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 16465  
 40 FR 20479  
 40 FR 27220  
 40 FR 20479

TABLE OF EXEMPT AND TYPE A QUANTITIES

Transport group <sup>1</sup>	Exempt quantity limit (in microcuries)	Type A quantity limit (in curies)
I	0.1	0.001
II	0.1	0.050
III	1	3
IV	1	30
V	1	30
VI	1	1000
VII	25,000	1000
Special Form	1	30

<sup>1</sup>The contents 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.

(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.

(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.

§ 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.

§ 20.207 Storage and control of licensed materials in unrestricted areas.

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

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

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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

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

(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); or

## § 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.

(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

(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.

## § 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.

(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 of the same 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



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 repackaged 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.

(b) 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.



§ 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.

(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, and Part 61 of this chapter.

(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 § 20.106, 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.

(3) Records of disposal of licensed materials made pursuant to §§ 20.202, 20.303, removed § 20.204, and Part 61 of this chapter are to be maintained until the Commission authorizes their disposition.

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

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

§ 20.402 Reports of theft or loss of licensed material.

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

(2) Reports must be made as follows:

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

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

(b) Each licensee who makes a report under paragraph (a) of this section shall, 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:

- (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 individ-

uals, circumstances under which the exposures occurred, and the extent of possible hazard to persons in unrestricted areas;

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

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

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

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

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

§ 20.403 Notifications of incidents.

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

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

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

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

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

(b) *Twenty-four hour notification.*

Each licensee shall within 24 hours of discovery of the event, report any event involving licensed material possessed by the licensee that may have caused or threatens to cause:

(1) Exposure of the whole body of any individual to 8 rems or more of radiation; exposure of the skin of the whole body of any individual to 30 rems or more of radiation; or exposure of the feet, ankles, hands, or forearms to 75 rems or more of radiation; or

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

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

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

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

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

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

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

§ 20.404 [Reserved]

§ 20.405 Reports of overexposures and excessive levels and concentrations.

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

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

(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 licensee;



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(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 of 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.<sup>1</sup>

(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

<sup>1</sup> 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.

year was in each of the following estimated exposure ranges:

Estimated whole body exposure range (mrem)	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+	

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 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:



Radionuclide	Quantity in curies
Cesium-137	1
Cobalt-60	1
Gold-198	100
Iodine-131	1
Iridium-192	10
Krypton-85	1,000
Plutonium-239	10
Technetium-99m	1,000

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.

§ 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.

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

EXCEPTIONS AND ADDITIONAL REQUIREMENTS

§ 20.501 Applications for exemptions.

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

§ 20.502 Additional requirements.

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

(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.

ENFORCEMENT

§ 20.601 Violations.

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

[Note removed 49 FR 19623]





APPENDIX B  
 Concentrations in Air and Water Above Natural Background  
 (See notes at end of appendix)

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

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APPENDIX B  
 Concentrations in Air and Water Above Natural Background—Continued  
 (See notes at end of appendix)

Element (atomic number)	Isotope <sup>1</sup>	Table I		Table B			
		Column 1	Column 2	Column 1	Column 2		
		† (μCi/ml) Air	(μCi/ml) Water	(μCi/ml) Air	(μCi/ml) Water		
Bromine (35)	Br 82	5	1 × 10 <sup>-14</sup>	8 × 10 <sup>-3</sup>	4 × 10 <sup>-4</sup>		
		1	2 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>	3 × 10 <sup>-4</sup>		
Cadmium (48)	Cd 109	5	5 × 10 <sup>-14</sup>	5 × 10 <sup>-3</sup>	6 × 10 <sup>-4</sup>		
		1	7 × 10 <sup>-4</sup>	3 × 10 <sup>-3</sup>	2 × 10 <sup>-4</sup>		
	Cd 113m	5	4 × 10 <sup>-14</sup>	7 × 10 <sup>-4</sup>	1 × 10 <sup>-3</sup>		
		1	4 × 10 <sup>-4</sup>	7 × 10 <sup>-4</sup>	3 × 10 <sup>-4</sup>		
Calcium (20)	Ca 45	5	2 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>	6 × 10 <sup>-4</sup>		
		1	2 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>	4 × 10 <sup>-4</sup>		
Cesium (55)	Cs 137	5	3 × 10 <sup>-10</sup>	3 × 10 <sup>-3</sup>	1 × 10 <sup>-3</sup>		
		1	1 × 10 <sup>-7</sup>	5 × 10 <sup>-3</sup>	4 × 10 <sup>-4</sup>		
Cesium (55)	Cs 137	5	3 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>	6 × 10 <sup>-4</sup>		
		1	3 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>	5 × 10 <sup>-4</sup>		
		Cf 249	5	2 × 10 <sup>-12</sup>	1 × 10 <sup>-4</sup>	5 × 10 <sup>-14</sup>	
			1	1 × 10 <sup>-10</sup>	7 × 10 <sup>-4</sup>	3 × 10 <sup>-12</sup>	
		Cf 250	5	5 × 10 <sup>-12</sup>	4 × 10 <sup>-4</sup>	3 × 10 <sup>-12</sup>	
			1	1 × 10 <sup>-10</sup>	7 × 10 <sup>-4</sup>	3 × 10 <sup>-12</sup>	
		Cf 251	5	2 × 10 <sup>-12</sup>	1 × 10 <sup>-4</sup>	4 × 10 <sup>-14</sup>	
			1	1 × 10 <sup>-10</sup>	8 × 10 <sup>-4</sup>	3 × 10 <sup>-12</sup>	
		Cf 252	5	5	4 × 10 <sup>-12</sup>	2 × 10 <sup>-4</sup>	2 × 10 <sup>-12</sup>
				1	3 × 10 <sup>-11</sup>	2 × 10 <sup>-4</sup>	1 × 10 <sup>-12</sup>
Cf 253	5	5	8 × 10 <sup>-10</sup>	6 × 10 <sup>-3</sup>	3 × 10 <sup>-11</sup>		
		1	8 × 10 <sup>-10</sup>	4 × 10 <sup>-3</sup>	2 × 10 <sup>-11</sup>		
Cf 254	5	5	5 × 10 <sup>-12</sup>	4 × 10 <sup>-4</sup>	2 × 10 <sup>-12</sup>		
		1	3 × 10 <sup>-12</sup>	4 × 10 <sup>-4</sup>	2 × 10 <sup>-12</sup>		
Carbon (6)	C 14 (CO <sub>2</sub> )	Sub	5 × 10 <sup>-12</sup>	2 × 10 <sup>-3</sup>	1 × 10 <sup>-3</sup>		
Cesium (55)	Cs 137	5	4 × 10 <sup>-7</sup>	3 × 10 <sup>-3</sup>	2 × 10 <sup>-3</sup>		
		1	2 × 10 <sup>-7</sup>	3 × 10 <sup>-3</sup>	9 × 10 <sup>-4</sup>		
		5	2 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>	9 × 10 <sup>-4</sup>		
		1	2 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>	4 × 10 <sup>-4</sup>		
Cesium (55)	Cs 134	5	1 × 10 <sup>-10</sup>	3 × 10 <sup>-4</sup>	7 × 10 <sup>-10</sup>		
		1	6 × 10 <sup>-10</sup>	3 × 10 <sup>-4</sup>	1 × 10 <sup>-10</sup>		
		5	1 × 10 <sup>-10</sup>	3 × 10 <sup>-4</sup>	1 × 10 <sup>-10</sup>		
		1	6 × 10 <sup>-10</sup>	3 × 10 <sup>-4</sup>	1 × 10 <sup>-10</sup>		
Cesium (55)	Cs 137	5	3 × 10 <sup>-10</sup>	7 × 10 <sup>-4</sup>	4 × 10 <sup>-10</sup>		
		1	3 × 10 <sup>-10</sup>	3 × 10 <sup>-4</sup>	1 × 10 <sup>-10</sup>		
		5	4 × 10 <sup>-10</sup>	3 × 10 <sup>-4</sup>	9 × 10 <sup>-11</sup>		
		1	6 × 10 <sup>-10</sup>	3 × 10 <sup>-4</sup>	6 × 10 <sup>-11</sup>		
		5	4 × 10 <sup>-10</sup>	3 × 10 <sup>-4</sup>	9 × 10 <sup>-11</sup>		
		1	1 × 10 <sup>-10</sup>	1 × 10 <sup>-4</sup>	4 × 10 <sup>-10</sup>		
		5	5 × 10 <sup>-10</sup>	3 × 10 <sup>-4</sup>	2 × 10 <sup>-10</sup>		
		1	9 × 10 <sup>-10</sup>	7 × 10 <sup>-4</sup>	3 × 10 <sup>-10</sup>		
		5	4 × 10 <sup>-10</sup>	2 × 10 <sup>-4</sup>	1 × 10 <sup>-10</sup>		
		1	2 × 10 <sup>-10</sup>	2 × 10 <sup>-4</sup>	6 × 10 <sup>-10</sup>		
Chlorine (17)	Cl 36	5	6 × 10 <sup>-10</sup>	4 × 10 <sup>-4</sup>	2 × 10 <sup>-10</sup>		
		1	1 × 10 <sup>-10</sup>	1 × 10 <sup>-4</sup>	5 × 10 <sup>-10</sup>		
		5	4 × 10 <sup>-10</sup>	2 × 10 <sup>-4</sup>	8 × 10 <sup>-10</sup>		
Chlorine (17)	Cl 38	5	2 × 10 <sup>-10</sup>	2 × 10 <sup>-4</sup>	6 × 10 <sup>-10</sup>		
		1	3 × 10 <sup>-10</sup>	1 × 10 <sup>-4</sup>	9 × 10 <sup>-10</sup>		
Chromium (24)	Cr 51	5	3 × 10 <sup>-10</sup>	1 × 10 <sup>-4</sup>	7 × 10 <sup>-10</sup>		
		1	1 × 10 <sup>-10</sup>	5 × 10 <sup>-4</sup>	4 × 10 <sup>-10</sup>		
		1	2 × 10 <sup>-10</sup>	5 × 10 <sup>-4</sup>	6 × 10 <sup>-10</sup>		

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APPENDIX B  
 Concentrations in Air and Water Above Natural Background—Continued  
 (See notes at end of appendix)

Element (atomic number)	Isotope	Table 1		Table 2	
		Column 1	Column 2	Column 1	Column 2
		† Air ( $\mu\text{Ci/ml}$ )	Water ( $\mu\text{Ci/ml}$ )	Air ( $\mu\text{Ci/ml}$ )	Water ( $\mu\text{Ci/ml}$ )
Cobalt (27)	Co 57	$3 \times 10^{-10}$	$2 \times 10^{-11}$	$1 \times 10^{-11}$	$5 \times 10^{-11}$
		$2 \times 10^{-11}$	$1 \times 10^{-11}$	$6 \times 10^{-12}$	$4 \times 10^{-11}$
	Co 58m	$2 \times 10^{-11}$	$8 \times 10^{-12}$	$6 \times 10^{-12}$	$3 \times 10^{-11}$
		$9 \times 10^{-12}$	$6 \times 10^{-12}$	$3 \times 10^{-12}$	$2 \times 10^{-11}$
	Co 58	$8 \times 10^{-12}$	$4 \times 10^{-12}$	$3 \times 10^{-12}$	$1 \times 10^{-11}$
		$5 \times 10^{-12}$	$3 \times 10^{-12}$	$2 \times 10^{-12}$	$9 \times 10^{-12}$
Copper (29)	Co 60	$3 \times 10^{-11}$	$1 \times 10^{-11}$	$1 \times 10^{-11}$	$5 \times 10^{-12}$
		$9 \times 10^{-12}$	$1 \times 10^{-11}$	$3 \times 10^{-12}$	$3 \times 10^{-11}$
Copper (29)	Co 64	$2 \times 10^{-12}$	$1 \times 10^{-12}$	$7 \times 10^{-13}$	$3 \times 10^{-12}$
		$1 \times 10^{-12}$	$6 \times 10^{-13}$	$4 \times 10^{-13}$	$2 \times 10^{-12}$
Curium (96)	Cm 242	$1 \times 10^{-10}$	$7 \times 10^{-11}$	$4 \times 10^{-11}$	$2 \times 10^{-11}$
		$2 \times 10^{-10}$	$7 \times 10^{-11}$	$6 \times 10^{-11}$	$2 \times 10^{-11}$
	Cm 243	$6 \times 10^{-12}$	$1 \times 10^{-11}$	$2 \times 10^{-12}$	$5 \times 10^{-12}$
		$1 \times 10^{-12}$	$7 \times 10^{-12}$	$3 \times 10^{-12}$	$2 \times 10^{-11}$
	Cm 244	$9 \times 10^{-12}$	$2 \times 10^{-11}$	$3 \times 10^{-12}$	$7 \times 10^{-12}$
		$1 \times 10^{-12}$	$8 \times 10^{-12}$	$3 \times 10^{-12}$	$3 \times 10^{-11}$
	Cm 245	$3 \times 10^{-12}$	$1 \times 10^{-11}$	$2 \times 10^{-12}$	$4 \times 10^{-12}$
		$1 \times 10^{-12}$	$8 \times 10^{-12}$	$4 \times 10^{-12}$	$3 \times 10^{-11}$
	Cm 246	$3 \times 10^{-12}$	$1 \times 10^{-11}$	$2 \times 10^{-12}$	$4 \times 10^{-12}$
		$1 \times 10^{-12}$	$8 \times 10^{-12}$	$4 \times 10^{-12}$	$3 \times 10^{-11}$
	Cm 247	$5 \times 10^{-12}$	$1 \times 10^{-11}$	$2 \times 10^{-12}$	$4 \times 10^{-12}$
		$1 \times 10^{-12}$	$6 \times 10^{-12}$	$4 \times 10^{-12}$	$3 \times 10^{-11}$
	Cm 248	$6 \times 10^{-12}$	$1 \times 10^{-11}$	$2 \times 10^{-12}$	$4 \times 10^{-12}$
		$1 \times 10^{-11}$	$4 \times 10^{-12}$	$4 \times 10^{-12}$	$1 \times 10^{-11}$
Cm 249	$1 \times 10^{-11}$	$6 \times 10^{-12}$	$4 \times 10^{-12}$	$2 \times 10^{-11}$	
	$1 \times 10^{-11}$	$6 \times 10^{-12}$	$4 \times 10^{-12}$	$2 \times 10^{-11}$	
Dysprosium (66)	Dy 165	$3 \times 10^{-10}$	$1 \times 10^{-11}$	$9 \times 10^{-12}$	$4 \times 10^{-11}$
		$2 \times 10^{-11}$	$1 \times 10^{-11}$	$7 \times 10^{-12}$	$4 \times 10^{-11}$
	Dy 166	$2 \times 10^{-11}$	$1 \times 10^{-11}$	$8 \times 10^{-12}$	$4 \times 10^{-11}$
		$2 \times 10^{-12}$	$1 \times 10^{-11}$	$7 \times 10^{-12}$	$4 \times 10^{-11}$
Einsteinium (99)	Es 253	$6 \times 10^{-10}$	$7 \times 10^{-11}$	$3 \times 10^{-11}$	$2 \times 10^{-11}$
		$6 \times 10^{-10}$	$7 \times 10^{-11}$	$2 \times 10^{-11}$	$2 \times 10^{-11}$
	Es 254m	$3 \times 10^{-11}$	$5 \times 10^{-12}$	$2 \times 10^{-12}$	$2 \times 10^{-11}$
		$6 \times 10^{-11}$	$5 \times 10^{-12}$	$2 \times 10^{-12}$	$2 \times 10^{-11}$
	Es 254	$2 \times 10^{-11}$	$4 \times 10^{-12}$	$6 \times 10^{-12}$	$1 \times 10^{-11}$
		$1 \times 10^{-12}$	$4 \times 10^{-12}$	$4 \times 10^{-12}$	$1 \times 10^{-11}$
	Es 255	$3 \times 10^{-10}$	$8 \times 10^{-11}$	$3 \times 10^{-11}$	$3 \times 10^{-11}$
		$4 \times 10^{-10}$	$8 \times 10^{-11}$	$1 \times 10^{-11}$	$3 \times 10^{-11}$
Berkelium (66)	Bk 169	$6 \times 10^{-11}$	$3 \times 10^{-11}$	$2 \times 10^{-11}$	$9 \times 10^{-12}$
		$4 \times 10^{-11}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$	$9 \times 10^{-12}$
	Bk 171	$7 \times 10^{-12}$	$3 \times 10^{-12}$	$2 \times 10^{-12}$	$1 \times 10^{-11}$
		$6 \times 10^{-12}$	$3 \times 10^{-12}$	$2 \times 10^{-12}$	$1 \times 10^{-11}$
Europium (63)	Eu 152	$4 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-11}$	$6 \times 10^{-12}$
	( $T/2 = 9.2$ hrs)	$3 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-11}$	$6 \times 10^{-12}$
	Eu 152	$1 \times 10^{-10}$	$2 \times 10^{-11}$	$4 \times 10^{-12}$	$8 \times 10^{-12}$
	( $T/2 = 13$ yrs)	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$6 \times 10^{-12}$	$8 \times 10^{-12}$
	Eu 154	$4 \times 10^{-10}$	$6 \times 10^{-11}$	$1 \times 10^{-11}$	$2 \times 10^{-11}$
		$7 \times 10^{-11}$	$6 \times 10^{-11}$	$2 \times 10^{-12}$	$2 \times 10^{-11}$
	$9 \times 10^{-11}$	$6 \times 10^{-11}$	$3 \times 10^{-12}$	$2 \times 10^{-11}$	
	$7 \times 10^{-11}$	$6 \times 10^{-11}$	$3 \times 10^{-12}$	$2 \times 10^{-11}$	

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APPENDIX B  
 Concentrations in Air and Water Above Natural Background—Continued  
 (See notes at end of appendix)

Element (atomic number)	Isotope	Table 1		Table 2	
		Column 1	Column 2	Column 1	Column 2
		Air ( $\mu\text{Ci/ml}$ )	Water ( $\mu\text{Ci/ml}$ )	Air ( $\mu\text{Ci/ml}$ )	Water ( $\mu\text{Ci/ml}$ )
Polonium (84)	Po 210	5	$6 \times 10^{-10}$	$4 \times 10^{-11}$	$2 \times 10^{-11}$
	Po 214	1	$7 \times 10^{-10}$	$4 \times 10^{-11}$	$2 \times 10^{-11}$
	Po 218	5	$2 \times 10^{-10}$	$1 \times 10^{-11}$	$6 \times 10^{-12}$
	Po 220	5	$1 \times 10^{-10}$	$1 \times 10^{-11}$	$4 \times 10^{-12}$
Francium (87)	Fr 223	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
	Fr 225	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
Radium (88)	Ra 226	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
	Ra 228	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
Actinium (89)	Ac 227	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
	Ac 228	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
Thorium (90)	Th 230	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
	Th 232	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
Protactinium (91)	Pa 231	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
	Pa 233	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
Uranium (92)	U 234	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
	U 238	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
Neptunium (93)	Np 237	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
	Np 239	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
Plutonium (94)	Pu 239	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
	Pu 240	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
Americium (95)	Am 241	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
	Am 243	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
Curium (96)	Cm 244	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
	Cm 246	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
Berkelium (97)	Bk 247	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
	Bk 249	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
Californium (98)	Cf 250	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
	Cf 252	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
Einsteinium (99)	Es 253	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
	Es 255	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
Fermium (100)	Fm 257	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$
	Fm 259	5	$2 \times 10^{-10}$	$3 \times 10^{-11}$	$1 \times 10^{-11}$



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APPENDIX B  
 Concentrations in Air and Water Above Natural Background - Continued  
 (See notes at end of appendix)

Element (atomic number)	Isotope	Table 1		Table 2		
		Column 1	Column 2	Column 1	Column 2	
		† (μCi/ml)	(μCi/ml)	(μCi/ml)	(μCi/ml)	
Iodine (53)	I 134	I	3 x 10 <sup>-14</sup>	3 x 10 <sup>-12</sup>	1 x 10 <sup>-11</sup>	6 x 10 <sup>-14</sup>
	I 135	S	1 x 10 <sup>-11</sup>	7 x 10 <sup>-14</sup>	1 x 10 <sup>-14</sup>	4 x 10 <sup>-14</sup>
Bismuth (83)	B 209	S	4 x 10 <sup>-11</sup>	3 x 10 <sup>-11</sup>	1 x 10 <sup>-11</sup>	7 x 10 <sup>-11</sup>
	B 210	I	4 x 10 <sup>-11</sup>	3 x 10 <sup>-11</sup>	1 x 10 <sup>-11</sup>	2 x 10 <sup>-11</sup>
	B 212	S	1 x 10 <sup>-11</sup>	1 x 10 <sup>-11</sup>	4 x 10 <sup>-11</sup>	4 x 10 <sup>-11</sup>
	B 214	S	3 x 10 <sup>-11</sup>	1 x 10 <sup>-11</sup>	8 x 10 <sup>-11</sup>	3 x 10 <sup>-11</sup>
Iron (26)	Fe 55	S	9 x 10 <sup>-11</sup>	2 x 10 <sup>-11</sup>	3 x 10 <sup>-11</sup>	6 x 10 <sup>-11</sup>
	Fe 59	S	1 x 10 <sup>-11</sup>	7 x 10 <sup>-11</sup>	3 x 10 <sup>-11</sup>	2 x 10 <sup>-11</sup>
Krypton (36)	Kr 83m	Sub	6 x 10 <sup>-11</sup>		1 x 10 <sup>-11</sup>	
	Kr 83	Sub	1 x 10 <sup>-11</sup>		3 x 10 <sup>-11</sup>	
	Kr 87	Sub	1 x 10 <sup>-11</sup>		2 x 10 <sup>-11</sup>	
	Kr 88	Sub	1 x 10 <sup>-11</sup>		2 x 10 <sup>-11</sup>	
Lanthanum (57)	La 140	S	2 x 10 <sup>-11</sup>	7 x 10 <sup>-11</sup>	3 x 10 <sup>-11</sup>	2 x 10 <sup>-11</sup>
		I	1 x 10 <sup>-11</sup>	7 x 10 <sup>-11</sup>	4 x 10 <sup>-11</sup>	2 x 10 <sup>-11</sup>
Lead (82)	Pb 203	S	3 x 10 <sup>-11</sup>	1 x 10 <sup>-11</sup>	9 x 10 <sup>-11</sup>	4 x 10 <sup>-11</sup>
	Pb 210	S	2 x 10 <sup>-11</sup>	1 x 10 <sup>-11</sup>	4 x 10 <sup>-11</sup>	1 x 10 <sup>-11</sup>
	Pb 212	I	2 x 10 <sup>-11</sup>	3 x 10 <sup>-11</sup>	8 x 10 <sup>-11</sup>	2 x 10 <sup>-11</sup>
	Pb 214	S	2 x 10 <sup>-11</sup>	6 x 10 <sup>-11</sup>	6 x 10 <sup>-11</sup>	2 x 10 <sup>-11</sup>
Lutetium (71)	Lu 177	S	6 x 10 <sup>-11</sup>	3 x 10 <sup>-11</sup>	2 x 10 <sup>-11</sup>	1 x 10 <sup>-11</sup>
		I	5 x 10 <sup>-11</sup>	3 x 10 <sup>-11</sup>	3 x 10 <sup>-11</sup>	1 x 10 <sup>-11</sup>
Manganese (25)	Mn 52	S	2 x 10 <sup>-11</sup>	1 x 10 <sup>-11</sup>	7 x 10 <sup>-11</sup>	3 x 10 <sup>-11</sup>
	Mn 54	S	1 x 10 <sup>-11</sup>	9 x 10 <sup>-11</sup>	3 x 10 <sup>-11</sup>	3 x 10 <sup>-11</sup>
	Mn 56	S	4 x 10 <sup>-11</sup>	4 x 10 <sup>-11</sup>	1 x 10 <sup>-11</sup>	1 x 10 <sup>-11</sup>
	Mn 57	I	4 x 10 <sup>-11</sup>	3 x 10 <sup>-11</sup>	1 x 10 <sup>-11</sup>	1 x 10 <sup>-11</sup>
Mercury (80)	Hg 197m	S	7 x 10 <sup>-11</sup>	6 x 10 <sup>-11</sup>	2 x 10 <sup>-11</sup>	2 x 10 <sup>-11</sup>
	Hg 199	I	6 x 10 <sup>-11</sup>	5 x 10 <sup>-11</sup>	3 x 10 <sup>-11</sup>	3 x 10 <sup>-11</sup>
	Hg 201	S	1 x 10 <sup>-11</sup>	9 x 10 <sup>-11</sup>	4 x 10 <sup>-11</sup>	3 x 10 <sup>-11</sup>
	Hg 203	S	3 x 10 <sup>-11</sup>	1 x 10 <sup>-11</sup>	9 x 10 <sup>-11</sup>	5 x 10 <sup>-11</sup>
Molybdenum (42)	Mo 99	S	7 x 10 <sup>-11</sup>	2 x 10 <sup>-11</sup>	2 x 10 <sup>-11</sup>	2 x 10 <sup>-11</sup>
		I	1 x 10 <sup>-11</sup>	3 x 10 <sup>-11</sup>	4 x 10 <sup>-11</sup>	1 x 10 <sup>-11</sup>
		I	2 x 10 <sup>-11</sup>	1 x 10 <sup>-11</sup>	7 x 10 <sup>-11</sup>	4 x 10 <sup>-11</sup>
Neodymium (60)	Nd 144	S	6 x 10 <sup>-11</sup>	2 x 10 <sup>-11</sup>	3 x 10 <sup>-11</sup>	7 x 10 <sup>-11</sup>
	Nd 146	I	3 x 10 <sup>-11</sup>	2 x 10 <sup>-11</sup>	1 x 10 <sup>-11</sup>	8 x 10 <sup>-11</sup>
	Nd 147	S	4 x 10 <sup>-11</sup>	2 x 10 <sup>-11</sup>	1 x 10 <sup>-11</sup>	6 x 10 <sup>-11</sup>
	Nd 149	S	2 x 10 <sup>-11</sup>	2 x 10 <sup>-11</sup>	6 x 10 <sup>-11</sup>	6 x 10 <sup>-11</sup>
	I	3 x 10 <sup>-11</sup>	8 x 10 <sup>-11</sup>	6 x 10 <sup>-11</sup>	3 x 10 <sup>-11</sup>	
	I	1 x 10 <sup>-11</sup>	6 x 10 <sup>-11</sup>	5 x 10 <sup>-11</sup>	3 x 10 <sup>-11</sup>	

APPENDIX B  
 Concentrations in Air and Water Above Natural Background—Continued  
 (See notes at end of appendix)

Element (atomic number)	Isotope <sup>1</sup>	Table I		Table II	
		Column 1	Column 2	Column 1	Column 2
		Air † (μCi/ml)	Water (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)
Neptunium (93)	Np 237	4 × 10 <sup>-11</sup>	9 × 10 <sup>-7</sup>	1 × 10 <sup>-11</sup>	3 × 10 <sup>-7</sup>
	Np 239	1 × 10 <sup>-10</sup>	9 × 10 <sup>-7</sup>	4 × 10 <sup>-11</sup>	3 × 10 <sup>-7</sup>
Nickel (28)	Ni 59	8 × 10 <sup>-7</sup>	4 × 10 <sup>-3</sup>	3 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>
	Ni 63	3 × 10 <sup>-7</sup>	6 × 10 <sup>-3</sup>	3 × 10 <sup>-7</sup>	3 × 10 <sup>-3</sup>
	Ni 64	6 × 10 <sup>-7</sup>	8 × 10 <sup>-3</sup>	3 × 10 <sup>-7</sup>	3 × 10 <sup>-3</sup>
	Ni 65	3 × 10 <sup>-7</sup>	2 × 10 <sup>-3</sup>	1 × 10 <sup>-7</sup>	7 × 10 <sup>-3</sup>
Niobium (Columbium) (41)	Nb 93m	3 × 10 <sup>-7</sup>	4 × 10 <sup>-3</sup>	3 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>
	Nb 95	1 × 10 <sup>-7</sup>	3 × 10 <sup>-3</sup>	2 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>
	Nb 97	2 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>	4 × 10 <sup>-7</sup>	4 × 10 <sup>-3</sup>
	Nb 98	3 × 10 <sup>-7</sup>	3 × 10 <sup>-3</sup>	2 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>
Osmium (76)	Os 185	1 × 10 <sup>-7</sup>	3 × 10 <sup>-3</sup>	2 × 10 <sup>-7</sup>	9 × 10 <sup>-3</sup>
	Os 191m	3 × 10 <sup>-7</sup>	2 × 10 <sup>-3</sup>	2 × 10 <sup>-7</sup>	7 × 10 <sup>-3</sup>
	Os 192	2 × 10 <sup>-7</sup>	7 × 10 <sup>-3</sup>	6 × 10 <sup>-7</sup>	3 × 10 <sup>-3</sup>
	Os 194	9 × 10 <sup>-7</sup>	7 × 10 <sup>-3</sup>	3 × 10 <sup>-7</sup>	2 × 10 <sup>-3</sup>
	Os 197	1 × 10 <sup>-7</sup>	3 × 10 <sup>-3</sup>	4 × 10 <sup>-7</sup>	2 × 10 <sup>-3</sup>
Palladium (46)	Pd 103	4 × 10 <sup>-7</sup>	2 × 10 <sup>-3</sup>	1 × 10 <sup>-7</sup>	6 × 10 <sup>-3</sup>
	Pd 105	3 × 10 <sup>-7</sup>	2 × 10 <sup>-3</sup>	9 × 10 <sup>-7</sup>	5 × 10 <sup>-3</sup>
	Pd 106	1 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>	5 × 10 <sup>-7</sup>	3 × 10 <sup>-3</sup>
	Pd 109	7 × 10 <sup>-7</sup>	8 × 10 <sup>-3</sup>	3 × 10 <sup>-7</sup>	3 × 10 <sup>-3</sup>
Phosphorus (15)	P 32	6 × 10 <sup>-7</sup>	2 × 10 <sup>-3</sup>	2 × 10 <sup>-7</sup>	9 × 10 <sup>-3</sup>
	P 33	4 × 10 <sup>-7</sup>	3 × 10 <sup>-3</sup>	1 × 10 <sup>-7</sup>	7 × 10 <sup>-3</sup>
Platinum (78)	Pt 191	7 × 10 <sup>-7</sup>	5 × 10 <sup>-3</sup>	2 × 10 <sup>-7</sup>	2 × 10 <sup>-3</sup>
	Pt 193m	8 × 10 <sup>-7</sup>	7 × 10 <sup>-3</sup>	3 × 10 <sup>-7</sup>	3 × 10 <sup>-3</sup>
	Pt 195	6 × 10 <sup>-7</sup>	4 × 10 <sup>-3</sup>	3 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>
	Pt 197	5 × 10 <sup>-7</sup>	3 × 10 <sup>-3</sup>	2 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>
Plutonium (94)	Pu 238	3 × 10 <sup>-7</sup>	2 × 10 <sup>-3</sup>	2 × 10 <sup>-7</sup>	9 × 10 <sup>-3</sup>
	Pu 239	2 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>	2 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>
	Pu 240	3 × 10 <sup>-7</sup>	8 × 10 <sup>-3</sup>	3 × 10 <sup>-7</sup>	3 × 10 <sup>-3</sup>
	Pu 241	2 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>	7 × 10 <sup>-7</sup>	5 × 10 <sup>-3</sup>
	Pu 242	4 × 10 <sup>-7</sup>	9 × 10 <sup>-3</sup>	1 × 10 <sup>-7</sup>	3 × 10 <sup>-3</sup>
	Pu 244	1 × 10 <sup>-7</sup>	4 × 10 <sup>-3</sup>	1 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>

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PART 20 • STANDARDS FOR PROTECTION AGAINST RADIATION

APPENDIX B  
 Concentrations in Air and Water Above Natural Background—Continued  
 (See notes at end of appendix)

Element (atomic number)	Isotope <sup>1</sup>	Table I		Table II		
		Column 1	Column 2	Column 1	Column 2	
		Ab † (μCi/ml)	Water (μCi/ml)	Ab (μCi/ml)	Water (μCi/ml)	
Plutonium (94)	Pu 242	5	3 × 10 <sup>-12</sup>	1 × 10 <sup>-14</sup>	6 × 10 <sup>-14</sup>	3 × 10 <sup>-14</sup>
	Pu 243	1	4 × 10 <sup>-11</sup>	9 × 10 <sup>-14</sup>	1 × 10 <sup>-12</sup>	3 × 10 <sup>-12</sup>
	Pu 244	1	3 × 10 <sup>-10</sup>	1 × 10 <sup>-12</sup>	6 × 10 <sup>-14</sup>	3 × 10 <sup>-14</sup>
Polonium (84)	Po 210	5	3 × 10 <sup>-10</sup>	2 × 10 <sup>-12</sup>	2 × 10 <sup>-11</sup>	7 × 10 <sup>-12</sup>
	Po 214	1	2 × 10 <sup>-9</sup>	8 × 10 <sup>-14</sup>	7 × 10 <sup>-12</sup>	3 × 10 <sup>-12</sup>
Potassium (19)	K 42	5	3 × 10 <sup>-12</sup>	9 × 10 <sup>-12</sup>	7 × 10 <sup>-14</sup>	3 × 10 <sup>-14</sup>
	K 43	1	1 × 10 <sup>-12</sup>	6 × 10 <sup>-12</sup>	4 × 10 <sup>-14</sup>	2 × 10 <sup>-14</sup>
Protactinium (89)	Pa 143	5	3 × 10 <sup>-12</sup>	9 × 10 <sup>-14</sup>	7 × 10 <sup>-14</sup>	3 × 10 <sup>-14</sup>
	Pa 144	1	3 × 10 <sup>-12</sup>	9 × 10 <sup>-14</sup>	3 × 10 <sup>-14</sup>	3 × 10 <sup>-14</sup>
Promethium (61)	Pm 147	5	6 × 10 <sup>-10</sup>	6 × 10 <sup>-12</sup>	3 × 10 <sup>-12</sup>	2 × 10 <sup>-12</sup>
	Pm 149	1	1 × 10 <sup>-12</sup>	6 × 10 <sup>-12</sup>	3 × 10 <sup>-12</sup>	2 × 10 <sup>-12</sup>
Protactinium (91)	Pa 230	5	3 × 10 <sup>-12</sup>	1 × 10 <sup>-12</sup>	6 × 10 <sup>-14</sup>	4 × 10 <sup>-14</sup>
	Pa 231	1	6 × 10 <sup>-10</sup>	7 × 10 <sup>-12</sup>	6 × 10 <sup>-11</sup>	2 × 10 <sup>-11</sup>
	Pa 233	5	1 × 10 <sup>-12</sup>	3 × 10 <sup>-12</sup>	4 × 10 <sup>-14</sup>	9 × 10 <sup>-14</sup>
	Pa 234	1	1 × 10 <sup>-10</sup>	6 × 10 <sup>-12</sup>	6 × 10 <sup>-12</sup>	2 × 10 <sup>-12</sup>
Radium (88)	Ra 223	5	3 × 10 <sup>-10</sup>	3 × 10 <sup>-12</sup>	6 × 10 <sup>-11</sup>	7 × 10 <sup>-12</sup>
	Ra 224	1	3 × 10 <sup>-10</sup>	1 × 10 <sup>-12</sup>	8 × 10 <sup>-12</sup>	4 × 10 <sup>-12</sup>
	Ra 226	5	3 × 10 <sup>-10</sup>	7 × 10 <sup>-12</sup>	2 × 10 <sup>-10</sup>	3 × 10 <sup>-10</sup>
	Ra 228	1	7 × 10 <sup>-11</sup>	2 × 10 <sup>-12</sup>	3 × 10 <sup>-11</sup>	3 × 10 <sup>-11</sup>
	Ra 228	5	3 × 10 <sup>-11</sup>	4 × 10 <sup>-12</sup>	3 × 10 <sup>-12</sup>	3 × 10 <sup>-12</sup>
Radium (86)	Ra 226	5	7 × 10 <sup>-11</sup>	6 × 10 <sup>-12</sup>	2 × 10 <sup>-12</sup>	3 × 10 <sup>-12</sup>
	Ra 228	1	4 × 10 <sup>-11</sup>	7 × 10 <sup>-12</sup>	1 × 10 <sup>-12</sup>	3 × 10 <sup>-12</sup>
Rhenium (75)	Re 185	5	3 × 10 <sup>-12</sup>	3 × 10 <sup>-12</sup>	1 × 10 <sup>-14</sup>	3 × 10 <sup>-14</sup>
	Re 186	1	3 × 10 <sup>-10</sup>	2 × 10 <sup>-12</sup>	3 × 10 <sup>-12</sup>	6 × 10 <sup>-14</sup>
	Re 187	5	6 × 10 <sup>-12</sup>	3 × 10 <sup>-12</sup>	9 × 10 <sup>-14</sup>	3 × 10 <sup>-14</sup>
	Re 188	1	2 × 10 <sup>-12</sup>	1 × 10 <sup>-12</sup>	6 × 10 <sup>-14</sup>	9 × 10 <sup>-14</sup>
	Re 189	5	9 × 10 <sup>-14</sup>	7 × 10 <sup>-12</sup>	3 × 10 <sup>-12</sup>	3 × 10 <sup>-12</sup>
	Re 190	1	3 × 10 <sup>-12</sup>	4 × 10 <sup>-12</sup>	2 × 10 <sup>-14</sup>	3 × 10 <sup>-14</sup>
Rhodium (45)	Rh 105m	5	4 × 10 <sup>-12</sup>	2 × 10 <sup>-12</sup>	1 × 10 <sup>-14</sup>	6 × 10 <sup>-14</sup>
	Rh 105	1	3 × 10 <sup>-12</sup>	9 × 10 <sup>-12</sup>	6 × 10 <sup>-14</sup>	3 × 10 <sup>-14</sup>
	Rh 106	5	6 × 10 <sup>-12</sup>	4 × 10 <sup>-12</sup>	3 × 10 <sup>-14</sup>	1 × 10 <sup>-14</sup>
Rubidium (37)	Rb 86	5	3 × 10 <sup>-12</sup>	3 × 10 <sup>-12</sup>	1 × 10 <sup>-14</sup>	7 × 10 <sup>-14</sup>
	Rb 87	1	7 × 10 <sup>-10</sup>	7 × 10 <sup>-12</sup>	2 × 10 <sup>-14</sup>	3 × 10 <sup>-14</sup>
	Rb 87	5	3 × 10 <sup>-12</sup>	3 × 10 <sup>-12</sup>	2 × 10 <sup>-14</sup>	1 × 10 <sup>-14</sup>
	Rb 87	1	7 × 10 <sup>-10</sup>	3 × 10 <sup>-12</sup>	3 × 10 <sup>-14</sup>	3 × 10 <sup>-14</sup>

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APPENDIX B  
 Concentrations in Air and Water Above Natural Background—Continued  
 (See notes at end of appendix)

Element (atomic number)	Isotope	Table 1		Table 2			
		Column 1	Column 2	Column 1	Column 2		
		Ab + (μCi/ml)	Water (μCi/ml)	Ab (μCi/ml)	Water (μCi/ml)		
Ruthenium (44)	Ru 97	5	2 × 10 <sup>-4</sup>	1 × 10 <sup>-3</sup>	6 × 10 <sup>-4</sup>	4 × 10 <sup>-4</sup>	
		1	2 × 10 <sup>-4</sup>	1 × 10 <sup>-3</sup>	6 × 10 <sup>-4</sup>	2 × 10 <sup>-4</sup>	
	Ru 103	5	5 × 10 <sup>-7</sup>	2 × 10 <sup>-3</sup>	2 × 10 <sup>-4</sup>	6 × 10 <sup>-4</sup>	
		1	6 × 10 <sup>-7</sup>	2 × 10 <sup>-3</sup>	2 × 10 <sup>-4</sup>	6 × 10 <sup>-4</sup>	
	Ru 106	5	7 × 10 <sup>-7</sup>	2 × 10 <sup>-3</sup>	2 × 10 <sup>-4</sup>	1 × 10 <sup>-4</sup>	
Samarium (62)	Sm 147	5	5 × 10 <sup>-7</sup>	2 × 10 <sup>-3</sup>	2 × 10 <sup>-4</sup>	1 × 10 <sup>-4</sup>	
		1	6 × 10 <sup>-7</sup>	2 × 10 <sup>-3</sup>	2 × 10 <sup>-4</sup>	1 × 10 <sup>-4</sup>	
	Sm 151	5	7 × 10 <sup>-11</sup>	2 × 10 <sup>-3</sup>	2 × 10 <sup>-4</sup>	6 × 10 <sup>-4</sup>	
		1	2 × 10 <sup>-11</sup>	2 × 10 <sup>-3</sup>	2 × 10 <sup>-4</sup>	6 × 10 <sup>-4</sup>	
	Sm 153	5	6 × 10 <sup>-11</sup>	1 × 10 <sup>-3</sup>	2 × 10 <sup>-4</sup>	4 × 10 <sup>-4</sup>	
Strontium (38)	Sr 86	5	1 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>	2 × 10 <sup>-4</sup>	4 × 10 <sup>-4</sup>	
		1	2 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>	6 × 10 <sup>-4</sup>	4 × 10 <sup>-4</sup>	
	Sr 87	5	4 × 10 <sup>-7</sup>	3 × 10 <sup>-3</sup>	2 × 10 <sup>-4</sup>	9 × 10 <sup>-4</sup>	
		1	5 × 10 <sup>-7</sup>	3 × 10 <sup>-3</sup>	2 × 10 <sup>-4</sup>	9 × 10 <sup>-4</sup>	
	Sr 90	5	5 × 10 <sup>-7</sup>	8 × 10 <sup>-3</sup>	6 × 10 <sup>-4</sup>	3 × 10 <sup>-4</sup>	
Selenium (34)	Se 75	5	1 × 10 <sup>-7</sup>	8 × 10 <sup>-3</sup>	5 × 10 <sup>-4</sup>	3 × 10 <sup>-4</sup>	
		1	1 × 10 <sup>-7</sup>	8 × 10 <sup>-3</sup>	4 × 10 <sup>-4</sup>	3 × 10 <sup>-4</sup>	
	Silicon (14)	Si 31	5	6 × 10 <sup>-4</sup>	3 × 10 <sup>-3</sup>	2 × 10 <sup>-3</sup>	9 × 10 <sup>-4</sup>
		1	1 × 10 <sup>-4</sup>	6 × 10 <sup>-3</sup>	3 × 10 <sup>-3</sup>	2 × 10 <sup>-3</sup>	
	Silver (47)	Ag 105	5	6 × 10 <sup>-7</sup>	3 × 10 <sup>-3</sup>	5 × 10 <sup>-4</sup>	1 × 10 <sup>-4</sup>
		1	8 × 10 <sup>-7</sup>	3 × 10 <sup>-3</sup>	3 × 10 <sup>-4</sup>	1 × 10 <sup>-4</sup>	
Ag 110m		5	2 × 10 <sup>-7</sup>	9 × 10 <sup>-3</sup>	7 × 10 <sup>-4</sup>	3 × 10 <sup>-4</sup>	
		1	1 × 10 <sup>-7</sup>	9 × 10 <sup>-3</sup>	3 × 10 <sup>-4</sup>	3 × 10 <sup>-4</sup>	
Ag 111		5	2 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>	1 × 10 <sup>-4</sup>	4 × 10 <sup>-4</sup>	
Sodium (11)	Na 22	5	2 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>	6 × 10 <sup>-4</sup>	4 × 10 <sup>-4</sup>	
		1	9 × 10 <sup>-7</sup>	9 × 10 <sup>-3</sup>	3 × 10 <sup>-4</sup>	3 × 10 <sup>-4</sup>	
	Na 24	5	1 × 10 <sup>-7</sup>	6 × 10 <sup>-3</sup>	4 × 10 <sup>-4</sup>	2 × 10 <sup>-4</sup>	
		1	1 × 10 <sup>-7</sup>	8 × 10 <sup>-3</sup>	5 × 10 <sup>-4</sup>	3 × 10 <sup>-4</sup>	
	Strontium (38)	Sr 83m	5	4 × 10 <sup>-11</sup>	2 × 10 <sup>-3</sup>	1 × 10 <sup>-4</sup>	7 × 10 <sup>-4</sup>
		1	2 × 10 <sup>-11</sup>	2 × 10 <sup>-3</sup>	1 × 10 <sup>-4</sup>	7 × 10 <sup>-4</sup>	
Sr 85		5	2 × 10 <sup>-7</sup>	3 × 10 <sup>-3</sup>	8 × 10 <sup>-4</sup>	1 × 10 <sup>-4</sup>	
		1	1 × 10 <sup>-7</sup>	3 × 10 <sup>-3</sup>	4 × 10 <sup>-4</sup>	2 × 10 <sup>-4</sup>	
Sr 89		5	3 × 10 <sup>-4</sup>	3 × 10 <sup>-3</sup>	3 × 10 <sup>-4</sup>	3 × 10 <sup>-4</sup>	
		1	4 × 10 <sup>-4</sup>	8 × 10 <sup>-3</sup>	1 × 10 <sup>-4</sup>	3 × 10 <sup>-4</sup>	
Sr 90		5	1 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>	3 × 10 <sup>-4</sup>	3 × 10 <sup>-4</sup>	
		1	3 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>	2 × 10 <sup>-4</sup>	4 × 10 <sup>-4</sup>	
Sr 91		5	4 × 10 <sup>-7</sup>	2 × 10 <sup>-3</sup>	2 × 10 <sup>-4</sup>	7 × 10 <sup>-4</sup>	
		1	3 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>	9 × 10 <sup>-4</sup>	5 × 10 <sup>-4</sup>	
Sulfur (16)	S 35	5	3 × 10 <sup>-7</sup>	2 × 10 <sup>-3</sup>	1 × 10 <sup>-4</sup>	6 × 10 <sup>-4</sup>	
		1	3 × 10 <sup>-7</sup>	2 × 10 <sup>-3</sup>	9 × 10 <sup>-4</sup>	6 × 10 <sup>-4</sup>	
	Tantalum (73)	Ta 182	5	3 × 10 <sup>-7</sup>	8 × 10 <sup>-3</sup>	9 × 10 <sup>-4</sup>	3 × 10 <sup>-4</sup>
	1	4 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>	1 × 10 <sup>-4</sup>	4 × 10 <sup>-4</sup>		
	1	2 × 10 <sup>-7</sup>	1 × 10 <sup>-3</sup>	7 × 10 <sup>-4</sup>	4 × 10 <sup>-4</sup>		

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APPENDIX B  
 Concentrations in Air and Water Above Natural Background—Continued  
 (See notes at end of appendix)

Element (atomic number)	Isotope	Table 1		Table 2	
		Column 1	Column 2	Column 1	Column 2
		Air † (μCi/ml)	Water (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)
Technetium (43)	Tc 90m	8 × 10 <sup>-11</sup>	4 × 10 <sup>-11</sup>	3 × 10 <sup>-11</sup>	1 × 10 <sup>-11</sup>
	Tc 90	2 × 10 <sup>-11</sup>	3 × 10 <sup>-11</sup>	1 × 10 <sup>-11</sup>	1 × 10 <sup>-11</sup>
	Tc 96	6 × 10 <sup>-17</sup>	3 × 10 <sup>-17</sup>	2 × 10 <sup>-17</sup>	1 × 10 <sup>-17</sup>
	Tc 97m	2 × 10 <sup>-17</sup>	1 × 10 <sup>-17</sup>	8 × 10 <sup>-18</sup>	3 × 10 <sup>-18</sup>
	Tc 97	2 × 10 <sup>-17</sup>	5 × 10 <sup>-18</sup>	5 × 10 <sup>-18</sup>	4 × 10 <sup>-18</sup>
	Tc 98m	1 × 10 <sup>-17</sup>	3 × 10 <sup>-18</sup>	4 × 10 <sup>-18</sup>	2 × 10 <sup>-18</sup>
	Tc 98	3 × 10 <sup>-17</sup>	2 × 10 <sup>-18</sup>	1 × 10 <sup>-18</sup>	8 × 10 <sup>-19</sup>
	Tc 99m	4 × 10 <sup>-11</sup>	2 × 10 <sup>-11</sup>	1 × 10 <sup>-11</sup>	6 × 10 <sup>-12</sup>
	Tc 99	1 × 10 <sup>-11</sup>	6 × 10 <sup>-12</sup>	5 × 10 <sup>-12</sup>	3 × 10 <sup>-12</sup>
Tellurium (52)	Te 125m	2 × 10 <sup>-14</sup>	1 × 10 <sup>-14</sup>	7 × 10 <sup>-15</sup>	3 × 10 <sup>-15</sup>
	Te 125	6 × 10 <sup>-18</sup>	3 × 10 <sup>-18</sup>	2 × 10 <sup>-18</sup>	2 × 10 <sup>-18</sup>
	Te 126m	4 × 10 <sup>-17</sup>	3 × 10 <sup>-18</sup>	1 × 10 <sup>-18</sup>	2 × 10 <sup>-18</sup>
	Te 127m	1 × 10 <sup>-17</sup>	3 × 10 <sup>-18</sup>	4 × 10 <sup>-18</sup>	1 × 10 <sup>-18</sup>
	Te 127	4 × 10 <sup>-18</sup>	2 × 10 <sup>-18</sup>	5 × 10 <sup>-19</sup>	6 × 10 <sup>-19</sup>
	Te 128m	3 × 10 <sup>-18</sup>	6 × 10 <sup>-19</sup>	6 × 10 <sup>-19</sup>	3 × 10 <sup>-19</sup>
	Te 128	9 × 10 <sup>-17</sup>	5 × 10 <sup>-18</sup>	3 × 10 <sup>-18</sup>	2 × 10 <sup>-18</sup>
	Te 129m	8 × 10 <sup>-18</sup>	1 × 10 <sup>-18</sup>	3 × 10 <sup>-18</sup>	3 × 10 <sup>-18</sup>
	Te 129	3 × 10 <sup>-18</sup>	6 × 10 <sup>-19</sup>	1 × 10 <sup>-18</sup>	2 × 10 <sup>-18</sup>
	Te 130m	4 × 10 <sup>-18</sup>	2 × 10 <sup>-18</sup>	2 × 10 <sup>-18</sup>	8 × 10 <sup>-19</sup>
	Te 130	4 × 10 <sup>-18</sup>	2 × 10 <sup>-18</sup>	1 × 10 <sup>-18</sup>	8 × 10 <sup>-19</sup>
Terbium (63)	Tb 160	2 × 10 <sup>-17</sup>	9 × 10 <sup>-18</sup>	7 × 10 <sup>-18</sup>	3 × 10 <sup>-18</sup>
	Tb 161	1 × 10 <sup>-17</sup>	6 × 10 <sup>-18</sup>	4 × 10 <sup>-18</sup>	2 × 10 <sup>-18</sup>
	Tb 162	2 × 10 <sup>-17</sup>	1 × 10 <sup>-17</sup>	3 × 10 <sup>-17</sup>	4 × 10 <sup>-17</sup>
	Tb 163	3 × 10 <sup>-17</sup>	1 × 10 <sup>-17</sup>	1 × 10 <sup>-17</sup>	4 × 10 <sup>-17</sup>
	Tb 164	2 × 10 <sup>-17</sup>	1 × 10 <sup>-17</sup>	9 × 10 <sup>-18</sup>	4 × 10 <sup>-18</sup>
Thallium (81)	Tl 200	1 × 10 <sup>-18</sup>	7 × 10 <sup>-19</sup>	4 × 10 <sup>-19</sup>	2 × 10 <sup>-19</sup>
	Tl 201	2 × 10 <sup>-18</sup>	9 × 10 <sup>-19</sup>	7 × 10 <sup>-19</sup>	3 × 10 <sup>-19</sup>
	Tl 202	9 × 10 <sup>-17</sup>	3 × 10 <sup>-17</sup>	3 × 10 <sup>-17</sup>	2 × 10 <sup>-17</sup>
	Tl 203	8 × 10 <sup>-17</sup>	4 × 10 <sup>-17</sup>	3 × 10 <sup>-17</sup>	1 × 10 <sup>-17</sup>
	Tl 204	2 × 10 <sup>-17</sup>	2 × 10 <sup>-17</sup>	6 × 10 <sup>-18</sup>	7 × 10 <sup>-18</sup>
Thorium (90)	Th 227	6 × 10 <sup>-17</sup>	3 × 10 <sup>-17</sup>	2 × 10 <sup>-17</sup>	1 × 10 <sup>-17</sup>
	Th 228	3 × 10 <sup>-10</sup>	2 × 10 <sup>-10</sup>	9 × 10 <sup>-11</sup>	6 × 10 <sup>-11</sup>
	Th 228m	2 × 10 <sup>-10</sup>	5 × 10 <sup>-10</sup>	1 × 10 <sup>-10</sup>	2 × 10 <sup>-10</sup>
	Th 228Ac	2 × 10 <sup>-10</sup>	5 × 10 <sup>-10</sup>	3 × 10 <sup>-10</sup>	7 × 10 <sup>-10</sup>
	Th 228Ra	6 × 10 <sup>-13</sup>	4 × 10 <sup>-13</sup>	2 × 10 <sup>-13</sup>	1 × 10 <sup>-13</sup>
	Th 228Th	2 × 10 <sup>-13</sup>	5 × 10 <sup>-13</sup>	8 × 10 <sup>-14</sup>	2 × 10 <sup>-13</sup>
	Th 228Pa	1 × 10 <sup>-11</sup>	9 × 10 <sup>-11</sup>	3 × 10 <sup>-11</sup>	3 × 10 <sup>-11</sup>
	Th 231	1 × 10 <sup>-10</sup>	7 × 10 <sup>-10</sup>	5 × 10 <sup>-10</sup>	2 × 10 <sup>-10</sup>
	Th 231Pa	1 × 10 <sup>-10</sup>	7 × 10 <sup>-10</sup>	4 × 10 <sup>-10</sup>	2 × 10 <sup>-10</sup>
	Th 232	3 × 10 <sup>-11</sup>	5 × 10 <sup>-11</sup>	1 × 10 <sup>-11</sup>	2 × 10 <sup>-11</sup>
Th natural	2 × 10 <sup>-11</sup>	1 × 10 <sup>-11</sup>	1 × 10 <sup>-11</sup>	4 × 10 <sup>-11</sup>	
		6 × 10 <sup>-11</sup>	6 × 10 <sup>-11</sup>	2 × 10 <sup>-11</sup>	2 × 10 <sup>-11</sup>
		6 × 10 <sup>-11</sup>	6 × 10 <sup>-11</sup>	2 × 10 <sup>-11</sup>	2 × 10 <sup>-11</sup>

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APPENDIX B  
 Concentrations in Air and Water Above Natural Background—Continued  
 (See notes at end of appendix)

Element (atomic number)	Isotope	Units	Table 1		Table 2	
			Column 1	Column 2	Column 1	Column 2
			† Air ( $\mu\text{Ci/ml}$ )	Water ( $\mu\text{Ci/ml}$ )	† Air ( $\mu\text{Ci/ml}$ )	Water ( $\mu\text{Ci/ml}$ )
Thorium (90)	Th 234	S	$6 \times 10^{-10}$	$3 \times 10^{-10}$	$3 \times 10^{-10}$	$3 \times 10^{-10}$
		I	$3 \times 10^{-10}$	$3 \times 10^{-10}$	$1 \times 10^{-10}$	$3 \times 10^{-10}$
Thorium (89)	Th 230	S	$4 \times 10^{-10}$	$1 \times 10^{-10}$	$1 \times 10^{-10}$	$5 \times 10^{-10}$
		I	$3 \times 10^{-10}$	$1 \times 10^{-10}$	$1 \times 10^{-10}$	$5 \times 10^{-10}$
	Th 231	S	$1 \times 10^{-10}$	$1 \times 10^{-10}$	$4 \times 10^{-10}$	$2 \times 10^{-10}$
Radium (88)	Ra 226	S	$3 \times 10^{-10}$	$1 \times 10^{-10}$	$6 \times 10^{-10}$	$3 \times 10^{-10}$
		I	$4 \times 10^{-10}$	$2 \times 10^{-10}$	$1 \times 10^{-10}$	$9 \times 10^{-10}$
	Ra 228	S	$3 \times 10^{-10}$	$2 \times 10^{-10}$	$3 \times 10^{-10}$	$6 \times 10^{-10}$
Tungsten (Wolfram) (74)	W 181	S	$8 \times 10^{-10}$	$3 \times 10^{-10}$	$3 \times 10^{-10}$	$3 \times 10^{-10}$
		I	$1 \times 10^{-10}$	$1 \times 10^{-10}$	$4 \times 10^{-10}$	$3 \times 10^{-10}$
	W 183	S	$6 \times 10^{-10}$	$4 \times 10^{-10}$	$3 \times 10^{-10}$	$1 \times 10^{-10}$
Uranium (92)	U 230	S	$1 \times 10^{-10}$	$2 \times 10^{-10}$	$1 \times 10^{-10}$	$4 \times 10^{-10}$
		I	$1 \times 10^{-10}$	$1 \times 10^{-10}$	$4 \times 10^{-10}$	$3 \times 10^{-10}$
	U 232	S	$1 \times 10^{-10}$	$8 \times 10^{-11}$	$3 \times 10^{-10}$	$3 \times 10^{-10}$
		I	$3 \times 10^{-10}$	$8 \times 10^{-11}$	$9 \times 10^{-10}$	$3 \times 10^{-10}$
	U 233	S	$3 \times 10^{-10}$	$9 \times 10^{-11}$	$3 \times 10^{-10}$	$3 \times 10^{-10}$
		I	$1 \times 10^{-10}$	$9 \times 10^{-11}$	$4 \times 10^{-10}$	$3 \times 10^{-10}$
	U 234	S <sup>4</sup>	$6 \times 10^{-10}$	$9 \times 10^{-11}$	$3 \times 10^{-10}$	$3 \times 10^{-10}$
		I	$1 \times 10^{-10}$	$5 \times 10^{-11}$	$4 \times 10^{-10}$	$3 \times 10^{-10}$
	U 235	S <sup>4</sup>	$3 \times 10^{-10}$	$8 \times 10^{-11}$	$3 \times 10^{-10}$	$3 \times 10^{-10}$
		I	$1 \times 10^{-10}$	$8 \times 10^{-11}$	$4 \times 10^{-10}$	$3 \times 10^{-10}$
Uranium (92)	U 236	S	$6 \times 10^{-10}$	$1 \times 10^{-10}$	$3 \times 10^{-10}$	$3 \times 10^{-10}$
		I	$1 \times 10^{-10}$	$1 \times 10^{-10}$	$4 \times 10^{-10}$	$3 \times 10^{-10}$
	U 238	S <sup>4</sup>	$7 \times 10^{-10}$	$1 \times 10^{-10}$	$3 \times 10^{-10}$	$4 \times 10^{-10}$
		I	$1 \times 10^{-10}$	$1 \times 10^{-10}$	$3 \times 10^{-10}$	$4 \times 10^{-10}$
	U 240	S	$2 \times 10^{-10}$	$1 \times 10^{-10}$	$8 \times 10^{-10}$	$3 \times 10^{-10}$
Uranium (92)	U-natural	S <sup>4</sup>	$2 \times 10^{-10}$	$1 \times 10^{-10}$	$6 \times 10^{-10}$	$3 \times 10^{-10}$
		I	$1 \times 10^{-10}$	$1 \times 10^{-10}$	$3 \times 10^{-10}$	$3 \times 10^{-10}$
Vanadium (23)	V 48	S	$2 \times 10^{-10}$	$9 \times 10^{-11}$	$6 \times 10^{-10}$	$3 \times 10^{-10}$
		I	$6 \times 10^{-10}$	$8 \times 10^{-11}$	$3 \times 10^{-10}$	$3 \times 10^{-10}$
Xenon (54)	Xe 131m	Sub	$2 \times 10^{-10}$		$4 \times 10^{-10}$	
	Xe 133	Sub	$1 \times 10^{-10}$		$3 \times 10^{-10}$	
	Xe 135m	Sub	$1 \times 10^{-10}$		$3 \times 10^{-10}$	
	Xe 135	Sub	$4 \times 10^{-10}$		$1 \times 10^{-10}$	
Ytterbium (70)	Yb 173	S	$7 \times 10^{-10}$	$3 \times 10^{-10}$	$3 \times 10^{-10}$	$1 \times 10^{-10}$
		I	$6 \times 10^{-10}$	$3 \times 10^{-10}$	$3 \times 10^{-10}$	$1 \times 10^{-10}$
Yttrium (39)	Y 90	S	$1 \times 10^{-10}$	$6 \times 10^{-10}$	$4 \times 10^{-10}$	$3 \times 10^{-10}$
		I	$1 \times 10^{-10}$	$6 \times 10^{-10}$	$3 \times 10^{-10}$	$3 \times 10^{-10}$
	Y 91m	S	$3 \times 10^{-10}$	$1 \times 10^{-10}$	$6 \times 10^{-10}$	$3 \times 10^{-10}$
		I	$3 \times 10^{-10}$	$1 \times 10^{-10}$	$6 \times 10^{-10}$	$3 \times 10^{-10}$
	Y 91	S	$4 \times 10^{-10}$	$8 \times 10^{-10}$	$1 \times 10^{-10}$	$3 \times 10^{-10}$
		I	$3 \times 10^{-10}$	$6 \times 10^{-10}$	$1 \times 10^{-10}$	$3 \times 10^{-10}$
	Y 92	S	$4 \times 10^{-10}$	$2 \times 10^{-10}$	$1 \times 10^{-10}$	$6 \times 10^{-10}$
		I	$3 \times 10^{-10}$	$2 \times 10^{-10}$	$1 \times 10^{-10}$	$6 \times 10^{-10}$
	Y 93	S	$2 \times 10^{-10}$	$8 \times 10^{-10}$	$4 \times 10^{-10}$	$3 \times 10^{-10}$
	I	$1 \times 10^{-10}$	$6 \times 10^{-10}$	$3 \times 10^{-10}$	$3 \times 10^{-10}$	



APPENDIX B

Concentrations in Air and Water Above Natural Background—Continued

Element (atomic number)	Isotope	Table I		Table II		
		Column 1	Column 2	Column 1	Column 2	
		Ab ( $\mu\text{Ci/ml}$ )	Water ( $\mu\text{Ci/ml}$ )	Ab ( $\mu\text{Ci/ml}$ )	Water ( $\mu\text{Ci/ml}$ )	
Radium (88)	Ra 226	1	$1 \times 10^{-11}$	$3 \times 10^{-11}$	$4 \times 10^{-10}$	$1 \times 10^{-10}$
		2	$6 \times 10^{-12}$	$2 \times 10^{-11}$	$2 \times 10^{-10}$	$2 \times 10^{-10}$
	Ra 228	1	$4 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$7 \times 10^{-11}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
	Ra 223	1	$7 \times 10^{-12}$	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$2 \times 10^{-11}$
		2	$9 \times 10^{-12}$	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$2 \times 10^{-11}$
Actinium (89)	Ac 227	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
	Ac 228	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
	Ac 226	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
Bismuth (83)	Bi 213	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
	Bi 214	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
	Bi 212	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
Bi 210	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$	
	2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$	
Polonium (84)	Po 210	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
	Po 212	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
	Po 214	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
Po 216	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$	
	2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$	
Uranium (92)	U 238	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
	U 235	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
	U 234	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
U 233	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$	
	2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$	
Thorium (90)	Th 232	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
	Th 230	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
	Th 228	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
Th 226	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$	
	2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$	
Plutonium (94)	Pu 239	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
	Pu 240	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
	Pu 241	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
Pu 242	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$	
	2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$	
Americium (95)	Am 241	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
	Am 243	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
	Am 242m	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
Am 242	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$	
	2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$	
Curium (96)	Cm 244	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
	Cm 246	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
	Cm 247	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
Cm 248	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$	
	2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$	
Neptunium (93)	Np 237	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
	Np 239	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
	Np 241	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
Np 243	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$	
	2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$	
Protactinium (91)	Pa 231	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
	Pa 233	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
	Pa 234m	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$
		2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$
Pa 234	1	$1 \times 10^{-11}$	$2 \times 10^{-11}$	$4 \times 10^{-10}$	$6 \times 10^{-10}$	
	2	$2 \times 10^{-11}$	$2 \times 10^{-11}$	$1 \times 10^{-10}$	$6 \times 10^{-11}$	

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.

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.

Any single radionuclide not listed above, which decays by alpha emission or spontaneous fission.

<sup>1</sup> Soluble (S), insoluble (I).

<sup>2</sup> "Ab" means the values given are for submersion in a homogeneous infinite cloud of airborne material.

<sup>3</sup> 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 (1/3) "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  $1.3 \times 10^5$  MeV of alpha particle energy.) The Table II value may be replaced by one-third (1/3) of a "working level." The limit on radon-222 concentrations in restricted areas may be based on an annual average.

<sup>4</sup> For soluble mixtures of U-235, U-234 and U-238 in air chemical toxicity may be the limiting factor. If the percent by weight (enrichment) of U-235 is less than 1, the concentration value for a 60-hour workweek, Table I is 0.3 milligrams uranium per cubic meter of air average. For any enrichment, the product of the average concentration and time  $t$ , exposure during a 60-hour workweek shall not exceed  $6 \times 10^{-4}$  SA  $\mu\text{Ci-hr/ml}$ , 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  $6.77 \times 10^{-4}$  curies per gram U. The specific activity for other mixtures of U-235, U-236 and U-238, if not known, shall be:

$$SA = 2.8 \times 10^{-4} \text{ curies/gram U} \left( \frac{U-235}{235} + \frac{U-238}{238} \right)$$

$$SA = (0.4 + 0.20 \text{ E} + 0.0004 \text{ P}) 10^{-4} \text{ E} 2.7$$

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

\* Amended 37 FR 23319.

\*\* Amended 39 FR 23990; fantome redesignated 40 FR 50704.

\*\*\* Amended 40 FR 50704.

† Amended 38 FR 29314.

‡ Amended 39 FR 25463; redesignated 40 FR 50704.

NOTE TO APPENDIX B

Note: In any case where there is a mixture in air in excess of more than one radionuclide, the limiting value 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 of the quantity present in the mixture and the limit otherwise established in Appendix B for the specific radionuclide where that is 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 MPCs are MPC<sub>A</sub>, MPC<sub>B</sub>, and MPC<sub>C</sub> respectively, then the concentrations shall be limited so that the following relationship exists:

$$\frac{C_A}{MPC_A} + \frac{C_B}{MPC_B} + \frac{C_C}{MPC_C} \leq 1$$

2. If either the identity or the concentration of any radionuclide is not known, the limiting value for that radionuclide shall be:

- a. For purposes of Table I, Col. 1— $4 \times 10^{-6}$
- b. For purposes of Table I, Col. 2— $4 \times 10^{-4}$
- c. For purposes of Table II, Col. 1— $2 \times 10^{-4}$
- d. For purposes of Table II, Col. 2— $3 \times 10^{-6}$

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

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

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

30 FR 15505

a. Element (atomic number) and isotope	Table I		Table II	
	Column 1 Air (uCi/m <sup>3</sup> )	Column 2 Water (uCi/ml)	Column 1 Air (uCi/m <sup>3</sup> )	Column 2 Water (uCi/ml)
If it is known that Sr 90, I 131, I 132, I 133, I 134, I 135, I 136, I 137, Ra 226, Ac 227, Ra 228, Th 230, Pa 231, Th 232, Th 234, Cm 244, Cf 254, and Pu 239 are not present.....		$4 \times 10^{-4}$		$4 \times 10^{-4}$
If it is known that Sr 90, I 131, I 132, I 133, I 134, I 135, I 136, I 137, Ra 226, Ac 227, Ra 228, Th 230, Pa 231, Th 232, Th 234, Cm 244, Cf 254, and Pu 239 are not present.....		$4 \times 10^{-4}$		$4 \times 10^{-4}$
If it is known that Sr 90, I 131, I 132, I 133, I 134, I 135, I 136, I 137, Ra 226, Ac 227, Ra 228, Th 230, Pa 231, Th 232, Th 234, Cm 244, Cf 254, and Pu 239 are not present.....		$2 \times 10^{-4}$		$4 \times 10^{-4}$
If it is known that I 131, I 132, I 133, I 134, I 135, I 136, I 137, Ra 226, Ac 227, Ra 228, Th 230, Pa 231, Th 232, Th 234, Cm 244, Cf 254, and Pu 239 are not present.....		$4 \times 10^{-4}$		$1 \times 10^{-4}$
If it is known that alpha-emitters and Sr 90, I 131, I 132, I 133, I 134, I 135, I 136, I 137, Ra 226, Ac 227, Ra 228, Th 230, Pa 231, Th 232, Th 234, Cm 244, Cf 254, and Pu 239 are not present.....	$1 \times 10^{-6}$		$1 \times 10^{-6}$	
If it is known that alpha-emitters and Pb 210, Ac 227, Ra 226, and Pu 239 are not present.....	$1 \times 10^{-6}$		$1 \times 10^{-6}$	
If it is known that alpha-emitters and Ac 227 are not present.....	$1 \times 10^{-6}$		$1 \times 10^{-6}$	
If it is known that Ac 227, Th 230, Pa 231, Pu 238, Pu 239, Pu 240, Pu 242, Pu 244, Cm 244, Cf 254, and Cf 255 are not present.....	$1 \times 10^{-6}$		$1 \times 10^{-6}$	

40 FR 50704

4. If a mixture of radionuclides consists of uranium and its daughters in equilibrium and the daughters are not present in the mixture, 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.

30 FR 23550

- a. For purposes of Table I, Col. 1— $1 \times 10^{-6}$  uCi/ml gross alpha activity; or  $5 \times 10^{-6}$  uCi/ml natural uranium; or 70 micrograms per cubic meter of air natural uranium.
- b. For purposes of Table II, Col. 1— $4 \times 10^{-6}$  uCi/ml gross alpha activity; or  $2 \times 10^{-6}$  uCi/ml natural uranium; or 8 micrograms per cubic meter of air natural uranium.

30 FR 15045

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 ( $C_i$ ) to the concentration limit for that radionuclide specified in Table II of Appendix B (MPC<sub>i</sub>) does not exceed the

(i.e.  $\frac{C_i}{MPC_i} \leq \frac{1}{10}$ ) and (b) the sum of such ratios for all the radionuclides considered as not present in the mixture does not exceed  $\frac{1}{10}$ .

$$\text{i.e. } \frac{C_1}{MPC_1} + \frac{C_2}{MPC_2} + \dots \leq \frac{1}{10}$$





PART 20 • STANDARDS FOR PROTECTION AGAINST RADIATION

APPENDIX D.—UNITED STATES NUCLEAR REGULATORY COMMISSION REGIONAL OFFICES

	Address	Telephone (24 hours)
Region I: Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.	USNRC, 621 Park Avenue, 6th Fl., Prudenz, PA 19406.	(215) 267-6000 (FTS) 489-1000
Region II: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, Puerto Rico, South Carolina, Tennessee, Virginia, Virgin Islands, and West Virginia.	USNRC, 101 Marietta Street, NW, Suite 2000, Atlanta, GA 30303.	(404) 331-4503 (FTS) 242-4500
Region III: Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin.	USNRC, 729 Roosevelt Road, Glen Elyn, IL 60137.	(312) 700-6500 (FTS) 250-5500
Region IV: Arkansas, Colorado, Iowa, Kansas, Louisiana, Minnesota, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah, and Wyoming.	USNRC, 811 Ryan Plaza Drive, Suite 1000, Arlington, TX 76011.	(817) 650-6100 (FTS) 720-6100
Region V: Alaska, Arizona, California, Hawaii, Nevada, Oregon, Pacific Trust Territories, and Washington.	USNRC, Region V Uranium Recovery Field Office, 729 Sierra Street, P.O. Box 25325, Denver, CO 80225. USNRC, 1480 Mars Lane, Suite 210, Walnut Creek, CA 94595.	(303) 234-7222 (FTS) 234-7222 (415) 943-3700 (FTS) 483-3700

50 10 40030

**UNITED STATES NUCLEAR REGULATORY COMMISSION  
RULES and REGULATIONS**

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

21.1

21.3(a)

**PART  
21**

**REPORTING OF DEFECTS AND NONCOMPLIANCE**

**GENERAL PROVISIONS**

- Sec.
- 21.1 Purpose.
- 21.2 Scope.
- 21.3 Definitions.
- 21.4 Interpretations.
- 21.5 Communications.
- 21.6 Posting requirements.
- 21.7 Exemptions.
- 21.8 Information collection requirements: OMB approval.

**NOTIFICATION**

- 21.21 Notification of failure to comply or existence of a defect.

**PROCUREMENT DOCUMENTS**

- 21.31 Procurement documents.

**INSPECTIONS, RECORDS**

- 21.41 Inspections.
- 21.51 Maintenance of records.

**ENFORCEMENT**

- 21.61 Failure to notify.

Authority: Sec. 701, 66 Stat. 946 as amended; sec. 234, 63 Stat. 444, as amended (42 U.S.C. 2201, 2202); sec. 302, as amended, 226, 66 Stat. 1242, as amended, 1266 (42 U.S.C. 5841, 5846).

For the purposes of sec. 223, 66 Stat. 956, as amended (42 U.S.C. 2273), §§ 21.1, 21.21(a), and 21.31 are issued under sec. 167b, 66 Stat. 948, as amended (42 U.S.C. 2207b); and §§ 21.21, 21.41, and 21.51 are issued under sec. 1610, 66 Stat. 960, as amended (42 U.S.C. 2201(c)).

**GENERAL PROVISIONS**

**§ 21.1 Purpose.**

The regulations in this part establish procedures and requirements for implementation of section 206 of the Energy Reorganization Act of 1974. That section requires any individual director or responsible officer of a firm constructing, owning, operating or supplying the components of any facility or activity which is licensed or otherwise regulated pursuant to the Atomic Energy Act of 1954, as amended, or the Energy Reorganization Act of 1974, who obtains information reasonably indicating: (a) That the facility, activity or basic component supplied to such facility or activity fails to comply with the Atomic Energy Act of 1954, as amended, or any applicable rule, regulation, order, or license of the Commission relating to substantial safety hazards or (b) that the facility, activity, or basic component supplied to such facility or activity contains defects, which could create a substantial

safety hazard, to immediately notify the Commission of such failure to comply or such defect, unless he has actual knowledge that the Commission has been adequately informed of such defect or failure to comply.

and, as authorized by law, the identity of anyone so reporting will be withheld from disclosure.<sup>1</sup>

**§ 21.3 Definitions.**

As used in this part:  
(a)(1) "Basic component," when applied to nuclear power reactors means a plant structure, system, component or part thereof necessary to assure (i) the integrity of the reactor coolant pressure boundary, (ii) the capability to shut down the reactor and maintain it in a safe shutdown condition, or (iii) the capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to those referred to in § 100.11 of this chapter.

(2) "Basic component," when applied to other facilities and when applied to other activities licensed pursuant to Parts 30, 40, 50, 60, 61, 70, 71, or 72 of this chapter, means a component, structure, system, or part thereof that is directly procured by the licensee of a facility or activity subject to the regulations in this part and in which a defect (see § 21.3(d)) or failure to comply with any applicable regulation in this chapter, order, or license issued by the Commission could create a substantial safety hazard (see § 21.3(h)).

(3) In all cases "basic component" includes design, inspection, testing, or consulting services important to safety that are associated with the component hardware, whether these services are performed by the component supplier or others.

**§ 21.2 Scope.**

The regulations in this part apply, except as specifically provided otherwise in Parts 31, 34, 35, 40, 60, 61, 70, or 72 of this chapter, to each individual, partnership, corporation, or other entity licensed pursuant to the regulations in this chapter to possess, use, and/or transfer within the United States source material, byproduct material, special nuclear material, and/or spent fuel, or to construct, manufacture, possess, own, operate and/or transfer within the United States, any production or utilization facility or independent spent fuel storage installation, and to each director (see § 21.3(f)) and responsible officer (see § 21.3(j)) of such a licensee. The regulations in this part apply also to each individual, corporation, partnership or other entity doing business within the United States, and each director and responsible officer of such organization, that constructs (see § 21.3(c)) a production or utilization facility licensed for manufacture, construction or operation (see § 21.3(h)) pursuant to Part 50 of this chapter or an independent spent fuel storage installation for the storage of spent fuel licensed pursuant to Part 72 of this chapter, or supplies (see § 21.3(i)) basic components (see § 21.3(a)) for a facility or activity licensed, other than for export, under Parts 30, 40, 50, 60, 61, 70, 71, or 72 of this chapter. Nothing in these regulations should be deemed to preclude either an individual or a manufacturer/supplier of a commercial grade item (see § 21.3(a-1)) not subject to the regulations in this part from reporting to the Commission a known or suspected defect or failure to comply

<sup>1</sup>NRC Regional Offices will accept collect telephone calls from individuals who wish to speak to NRC representatives concerning nuclear safety-related problems. The location and telephone numbers (for nights and holidays as well as regular hours) are listed below:

Report:	
I (Preserve)	(215) 337-6285
II (Albany)	(404) 331-4503
III (Chicago)	(312) 760-3300
IV (Dallas)	(817) 628-6285
IV (Utah) Recovery Field Office (Denver)	(303) 256-7288
V (San Francisco)	(415) 643-3700

(4) A commercial grade item is not a part of a basic component until after dedication (see § 21.3(e-1)).

(e-1) "Commercial grade item" means an item that is (1) not subject to design or specification requirements that are unique to facilities or activities licensed pursuant to Parts 30, 40, 50, 60, 70, 71, or 72 of this chapter and (2) used in applications other than facilities or activities licensed pursuant to Parts 30, 40, 50, 60, 70, 71, or 72 of this chapter and (3) to be ordered from the manufacturer/supplier on the basis of specifications set forth in the manufacturer's published product description (for example a catalog).

(b) "Commission" means the Nuclear Regulatory Commission or its duly authorized representatives.

(c) "Constructing" or "construction" means the design, manufacture, fabrication, placement, erection, installation, modification, inspection, or testing of a facility or activity which is subject to the regulations in this part and consulting services related to the facility or activity that are important to safety.

(e-1) "Dedication" of a commercial grade item occurs after receipt when that item is designated for use as a basic component.

(d) "Defect" means:

(1) A deviation (see § 21.3(e)) in a basic component delivered to a purchaser for use in a facility or an activity subject to the regulations in this part if, on the basis of an evaluation (see § 21.3(g)), the deviation could create a substantial safety hazard; or

(2) The installation, use, or operation of a basic component containing a defect as defined in paragraph (d)(1) of this section; or

(3) A deviation in a portion of a facility subject to the construction permit or manufacturing licensing requirements of Part 50 of this chapter provided the deviation could, on the basis of an evaluation, create a substantial safety hazard and the portion of the facility containing the deviation has been offered to the purchaser for acceptance; or

(4) A condition or circumstance involving a basic component that could contribute to the exceeding of a safety limit, as defined in the technical specifications of a license for operation issued pursuant to Part 50 of this chapter.

(e) "Deviation" means a departure from the technical requirements included in a procurement document (see § 21.3(i)).

(f) "Director" means an individual, appointed or elected according to law, who is authorized to manage and direct the affairs of a corporation, partnership or other entity. In the case of an individual proprietorship, "director" means the individual.

(g) "Evaluation" means the process accomplished by or for a licensee to determine whether a particular deviation could create a substantial safety hazard.

(h) "Operating" or "operation" means the operation of a facility or the conduct of a licensed activity which is subject to the regulations in this part and consulting services related to operations that are important to safety.

(i) "Procurement document" means a contract that defines the requirements which facilities or basic components must meet in order to be considered acceptable by the purchaser.

(j) "Responsible officer" means the president, vice-president or other individual in the organization of a corporation, partnership, or other entity who is vested with executive authority over activities subject to this part.

(k) "Substantial safety hazard" means a loss of safety function to the extent that there is a major reduction in the degree of protection provided to public health and safety for any facility or activity licensed, other than for export, pursuant to Parts 30, 40, 50, 60, 70, 71, or 72 of this chapter.

(l) "Supplying" or "supplies" means contractually responsible for a basic component used or to be used in a facility or activity which is subject to the regulations in this part.

#### § 21.4 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.

#### § 21.5 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, or to the Director of a Regional Office at the address specified in Appendix D of Part 20 of this chapter. Communications and reports also may be delivered in person at the Commission's offices at 1717 H Street NW., Washington, D.C.; at 7920 Norfolk Avenue, Bethesda, Md.; or at a Regional Office at the location specified in Appendix D of Part 20 of this chapter.

#### § 21.6 Posting requirements.

(a) Each individual, partnership, corporation or other entity subject to the regulations in this part, shall post current copies of the following documents in a conspicuous position on any premises, within the United States where the activities subject to this part are conducted (1) the regulations in this part, (2) Section 206 of the Energy Reorganization Act of 1974, and (3) procedures adopted pursuant to the regulations in this part.

(b) If posting of the regulations in this part or the procedures adopted pursuant to the regulations in this part is not practicable, the licensee or firm subject to the regulations in this part may, in addition to posting section 206, post a notice which describes the regulations/procedures, including the name of the individual to whom reports may be made, and states where they may be examined.

(c) The effective date of this section has been deferred until January 8, 1978.



**§ 21.7 Exemptions.**

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 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.

Suppliers of commercial grade items are exempt from the provisions of this part to the extent that they supply commercial grade items.

**§ 21.8 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 3150-0035.

(b) The approved information collection requirements contained in this part appear in §§ 21.21 and 21.31.

**NOTIFICATION****§ 21.21 Notification of failure to comply or existence of a defect.**

(a) Each individual, corporation, partnership or other entity subject to the regulations in this part shall adopt appropriate procedures to:

(1) Provide for: (i) Evaluating deviations or (ii) informing the licensee or purchaser of the deviation in order that the licensee or purchaser may cause the deviation to be evaluated unless the deviation has been corrected; and

(2) Assure that a director or responsible officer is informed if the construction or operation of a facility, or activity, or a basic component supplied for such facility or activity:

(i) Fails to comply with the Atomic Energy Act of 1954, as amended, or any applicable rule, regulation, order or license of the Commission relating to a substantial safety hazard, or

(ii) Contains a defect. The effective date of this paragraph has been deferred until January 6, 1978.

(b)(1) A director or responsible officer subject to the regulations of this part or a designated person shall notify the Commission when he obtains information reasonably indicating a failure to comply or a defect affecting (i) the construction or operation of a facility or an activity within the United

States that is subject to the licensing requirements under Parts 30, 40, 50, 60, 61, 70, 71, or 72 of this chapter and that is within his organization's responsibility or (ii) a basic component that is within his organization's responsibility and is supplied for a facility or an activity within the United States that is subject to the licensing requirements under Parts 30, 40, 50, 60, 61, 70, 71, or 72 of this chapter. The above notification is not required if such individual has actual knowledge that the Commission has been adequately informed of such defect or such failure to comply.

(2) Initial notification required by this paragraph shall be made within two days following receipt of the information. Notification shall be made to the Director, Office of Inspection and Enforcement, or to the Director of a Regional Office. If initial notification is by means other than written communication, a written report shall be submitted to the appropriate Office within 5 days after the information is obtained. Three copies of each report shall be submitted to the Director, Office of Inspection and Enforcement.

(3) The written report required by this paragraph shall include, but need not be limited to, the following information, to the extent known:

(i) Name and address of the individual or individuals informing the Commission.

(ii) Identification of the facility, the activity, or the basic component supplied for such facility or such activity within the United States which fails to comply or contains a defect.

(iii) Identification of the firm constructing the facility or supplying the basic component which fails to comply or contains a defect.

(iv) Nature of the defect or failure to comply and the safety hazard which is created or could be created by such defect or failure to comply.

(v) The date on which the information of such defect or failure to comply was obtained.

(vi) In the case of a basic component which contains a defect or fails to comply, the number and location of all such components in use at, supplied for, or being supplied for one or more facilities or activities subject to the regulations in this part.

(vii) The corrective action which has been, is being, or will be taken; the name of the individual or organization responsible for the action; and the length of time that has been or will be taken to complete the action.

(viii) Any advice related to the defect or failure to comply about the facility, activity, or basic component that has been, is being, or will be given to purchasers or licensees.

(4) The director or responsible officer may authorize an individual to provide the notification required by this paragraph, provided that, this

shall not relieve the director or responsible officer of his or her responsibility under this paragraph.

(c) Individuals subject to paragraph (b) of this section may be required by the Commission to supply additional information related to the defect or failure to comply.

**PROCUREMENT DOCUMENTS****§ 21.31 Procurement documents.**

Each individual, corporation, partnership or other entity subject to the regulations in this part shall assure that each procurement document for a facility, or a basic component issued by him, her or it on or after January 6, 1978 specifies, when applicable, that the provisions of 10 CFR Part 21 apply.

**INSPECTIONS, RECORDS****§ 21.41 Inspections.**

Each individual, corporation, partnership or other entity subject to the regulations in this part shall permit duly authorized representatives of the Commission, to inspect its records, premises, activities, and basic components as necessary to effectuate the purposes of this part.

**§ 21.51 Maintenance of records.**

(a) Each licensee of a facility or activity subject to the regulations in this part shall maintain such records in connection with the licensed facility or activity as may be required to assure compliance with the regulations in this part.

(b) Each individual, corporation, partnership, or other entity subject to the regulations in this part shall prepare records in connection with the designs, manufacture, fabrication, placement, erection, installation, modification, inspection, or testing of any facility, basic component supplied for any licensed facility or to be used in any licensed activity sufficient to assure compliance with the regulations in this part. After delivery of the facility or component and prior to the destruction of the records relating to evaluations (see § 21.3(g)) or notifications to the Commission (see § 21.21), such records shall be offered to the purchaser of the facility or component. If such purchaser determines any such records:

(1) Are not related to the creation of a substantial safety hazard, he may authorize such records to be destroyed, or

(2) Are related to the creation of a substantial safety hazard, he shall cause such records to be offered to the organization to which he supplies basic components or for which he constructs a facility or activity.

If such purchaser is unable to make the determination as required above

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then the responsibility for making the determination shall be transferred to the individual, corporation, partnership, or other entity subject to the regulations in this part that issued the procurement document to the purchaser. In the event that the determination cannot be made at that level then the responsibility shall be transferred in a similar manner to another individual, corporation, partnership, or other entity subject to the regulations in this part, until, if necessary, the licensee shall make the determination.

(c) Records that are prepared only for the purpose of assuring compliance with the regulations in this part and are not related to evaluations or notifications to the Commission may be destroyed after delivery of the facility or component.

(d) The effective date of the section has been deferred until January 6, 1978.

## ENFORCEMENT

## § 21.51 Failure to notify.

Any director or responsible officer subject to the regulations in this part who knowingly and consciously fails to provide the notice required by § 21.21 shall be subject to a civil penalty equal to the amount provided by section 234 of the Atomic Energy Act of 1954, as amended.

[Note removed 49 FR 19623]



UNITED STATES NUCLEAR REGULATORY COMMISSION  
RULES and REGULATIONS

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

34.1

34.8(b)

**PART  
34**

**LICENSES FOR RADIOGRAPHY AND RADIATION SAFETY  
REQUIREMENTS FOR RADIOGRAPHIC OPERATIONS**

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- 34.43 Radiation surveys and survey records.
- 34.44 Supervision of radiographers' assistants.
- EXEMPTIONS
- 34.51 Applications for exemptions.
- Appendix A.

Authority: Secs. 81, 161, 162, 163, 88 Stat. 935, 948, 953, 954, as amended (42 U.S.C. 2111, 2201, 2232, 2233); sec. 201, 88 Stat. 1242, as amended (42 U.S.C. 5841).

Section 34.32 also issued under sec. 205, 88 Stat. 1246 (42 U.S.C. 5846).

For the purposes of sec. 223, 88 Stat. 958, as amended (42 U.S.C. 2273); §§ 34.22, 34.23,

34.24, 34.25 (a), (b), and (d), 34.28, 34.29, 34.31 (a) and (b), 34.32, 34.33 (a), (c), and (d), 34.41,

34.42, 34.43(a), (b), and (c), and 34.44 are

issued under sec. 161b, 88 Stat. 948, as amended (42 U.S.C. 2201(b)); and §§ 34.11(d),

34.25 (c) and (d), 34.26, 34.27, 34.28(b),

34.29(c), 34.31(c), 34.33 (b) and (e), and

34.43(d) are issued under sec. 161c, 88 Stat.

950, as amended (42 U.S.C. 2201(c)); §§ 34.2,

34.11, 34.22, 34.28, 34.29, 34.31, 34.32, 34.33,

34.43, 34.44, 34.51, and Appendix A—

(Amended)

§ 34.1 Purpose and scope.

This part prescribes requirements for the issuance of licenses for the use of sealed sources containing byproduct material and radiation safety requirements for persons using such sealed sources in radiography. The provisions and requirements of this part are in addition to, and not in substitution for, other requirements of this chapter. In particular, the provisions of Part 30 of this chapter apply to applications and licenses subject to this part. Nothing in this part shall apply to uses of byproduct material for medical diagnosis or therapy.

§ 34.2 Definitions.

As used in this part:

"Permanent radiographic installation" means a shielded installation or structure designed or intended for radiography and in which radiography is regularly performed.

"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;

"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;

"Radiographic exposure device" means any instrument containing a sealed source fastened or contained therein, in which the sealed source or shielding thereof may be moved, or otherwise changed, from a shielded to unshielded position for purposes of making a radiographic exposure;

"Radiography" means the examination of the structure of materials by nondestructive methods, utilizing sealed sources of byproduct materials;

"Sealed source" means any byproduct material that is encased in a

capsule designed to prevent leakage or escape of the byproduct material;

"Storage area" means any location, facility, or vehicle which is used to store, to transport, or to secure a radiographic exposure device, a storage container, or a sealed source when it is not in use and which is locked or has a physical barrier to prevent accidental exposure, tampering with, or unauthorized removal of the device, container, or source.

"Storage container" means a device in which sealed sources are transported or stored.

"Source changer" means a device designed and used for replacement of sealed sources in radiographic exposure devices, including those also used for transporting and storage of sealed sources;

§ 34.3 Applications for specific licenses.

A person may file an application for specific license for use of sealed sources in radiography in duplicate on NRC Form 313, "Application for Material License," in accordance with the provisions of § 30.32 of this chapter.

§ 34.8 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. 3601 et seq.). OMB has approved the information collection requirements contained in this part under control number 3150-0007.

(b) The approved information collection requirements contained in this part appear in §§ 34.11, 34.24, 34.25, 34.26, 34.27, 34.28, 34.29, 34.31, 34.32, 34.33, and 34.43.



(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 § 34.2, Form NRC-312R is approved under control number 3180-0022.

#### Subpart A—Specific Licensing Requirements

##### § 34.11 Issuance of specific licenses for use of sealed sources in radiography.

An application for a specific license for use of sealed sources in radiography will be approved if:

(a) The applicant satisfies the general requirements specified in § 30.33 of this chapter;

(b) The applicant will have an adequate program for training radiographers and radiographers' assistants and submits to the Commission a schedule or description of such program which specifies the:

- (1) Initial training;
- (2) Periodic training;
- (3) On-the-job training;

(4) Means to be used by the licensee to determine the radiographer's knowledge and understanding of and ability to comply with Commission regulations and licensing requirements, and the operating and emergency procedures of the applicant; and

(5) Means to be used by the licensee to determine the radiographer's assistant's knowledge and understanding of and ability to comply with the operating and emergency procedures of the applicant;

(c) The applicant has established and submits to the Commission satisfactory written operating and emergency procedures as described in § 34.32;

(d) The applicant has established and submits to the Commission a description of its inspection program adequate to ensure that its radiographers and radiographers' assistants follow the Commission's regulatory requirements and the applicant's operating and emergency procedures. The inspection program must:

- (1) Include observation of the performance of each radiographer and radiographer's assistant during an actual radiographic operation at intervals not to exceed three months;
- (2) Provide that, if a radiographer or a radiographer's assistant has not participated in a radiographic operation for more than three months since the

last inspection, that individual's performance must be observed and recorded the next time the individual participates in a radiographic operation; and

(3) Include the retention of inspection records on the performance of radiographers or radiographers' assistants for three years.

(e) The applicant submits a description of its over-all organizational structure pertaining to the radiography program, including specified delegations of authority and responsibility for operation of the program; and

(f) The applicant who desires to conduct his own leak tests has established adequate procedures to be followed in leak testing sealed sources, for possible leakage and contamination and submits to the Commission a description of such procedures including:

- (1) Instrumentation to be used,
- (2) Method of performing test, e.g., points on equipment to be smeared and method of taking smear, and
- (3) Pertinent experience of the person who will perform the test.

#### Subpart B—Radiation Safety Requirements

##### EQUIPMENT CONTROL

##### § 34.21 Limits on levels of radiation for radiographic exposure devices and storage containers.

Radiographic exposure devices measuring less than four (4) inches from the sealed source storage position to any exterior surface of the device shall have no radiation level in excess of 50 milliroentgens per hour at six (6) inches from any exterior surface of the device. Radiographic exposure devices measuring a minimum of four (4) inches from the sealed source storage position to any exterior surface of the device, and all storage containers for sealed sources or for radiographic exposure devices, shall have no radiation level in excess of 200 milliroentgens per hour at any exterior surface, and ten (10) milliroentgens per hour at one meter from any exterior surface. The radiation levels specified are with the sealed source in the shielded (i.e., "off") position.

##### § 34.22 Locking of radiographic exposure devices, storage containers, and source changers.

(a) Each radiographic exposure device shall have a lock or outer locked container designed to prevent unauthorized or accidental removal of the sealed source from its shielded position. The exposure device or its container shall be kept locked when not under the direct surveillance of a radiographer or a radiographer's

assistant or as otherwise may be authorized in § 34.41. In addition, during radiographic operations the sealed source assembly shall be secured in the shielded position each time the source is returned to that position.

(b) Each sealed source storage container and source changer shall have a lock or outer locked container designed to prevent unauthorized or accidental removal of the sealed source from its shielded position. Storage containers and source changers shall be kept locked when containing sealed sources except when under the direct surveillance of a radiographer or a radiographer's assistant.

##### § 34.23 Storage precautions.

Locked radiographic exposure devices and storage containers shall be physically secured to prevent tampering or removal by unauthorized personnel.

##### § 34.24 Radiation survey instruments.

The licensee shall maintain sufficient calibrated and operable radiation survey instruments to make physical radiation surveys as required by this part and Part 20 of this chapter.

Each radiation survey instrument shall be calibrated at intervals not to exceed three months and after each instrument servicing and a record shall be maintained of the results of each instrument calibration and date thereof for two years after the date of calibration.

Instrumentation required by this section shall have a range such that two milliroentgens per hour through one roentgen per hour can be measured.

##### § 34.25 Leak testing, repair, tagging, opening, modification and replacement of sealed sources.

(a) The replacement of any sealed source fastened to or contained in a radiographic exposure device and leak testing, repair, tagging, opening or any other modification of any sealed source shall be performed only by persons specifically authorized by the Commission to do so.

(b) Each sealed source shall be tested for leakage at intervals not to exceed 6 months. In the absence of a certificate from a transferor that a test has been made within the 6 months prior to the transfer, the sealed source shall not be put into use until tested.

(c) The leak test shall be capable of detecting the presence of 0.005 microcurie of removable contamination on the sealed source. An acceptable leak test for sources in the possession of a radiography licensee would be to test at the nearest accessible point to the sealed source storage position, or other appropriate measuring point, by a procedure to be approved pursuant to § 34.11(f).

Records of leak test results shall be kept in units of microcuries and maintained for inspection by the Commission for six months after the next required leak test is performed or until the sealed source is transferred or disposed of.

(d) Any test conducted pursuant to paragraphs (b) and (c) of this section which reveals the presence of 0.005 microcurie or more of removable radioactive material shall be considered evidence that the sealed source is leaking. The licensee shall immediately withdraw the equipment involved from use and shall cause it to be decontaminated and repaired or to be disposed of, in accordance with Commission regulations. A report shall be filed, within 5 days of the test, with the Director of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, describing the equipment involved, the test results, and the corrective action taken. A copy of such report shall be sent to the Director of the appropriate Nuclear Regulatory Commission's Inspection and Enforcement Regional Office listed in Appendix D of Part 20 of this chapter "Standards for Protection Against Radiation."

(e) A sealed source which is not fastened to or contained in a radiographic exposure device shall have permanently attached to it a durable tag at least one (1) inch square bearing the prescribed radiation caution symbol in conventional colors, magenta or purple on a yellow background, and at least the instructions: "Danger—Radioactive Material—Do Not Handle—Notify Civil Authorities if Found."

#### § 34.26 Quarterly inventory.

Each licensee shall conduct a quarterly physical inventory to account for all sealed sources received and possessed under his license. The records of the inventories shall be maintained for two years from the date of the inventory for inspection by the Commission, and shall include the quantities and kinds of by-product material, location of sealed sources, and the date of the inventory.

#### § 34.27 Utilization logs.

Each licensee shall maintain current logs, which shall be kept available for two years from the date of the recorded event, for inspection by the Commission, at the address specified in the license, showing for each sealed source the following information:

- (a) A description (or make and model number) of the radiographic exposure device or storage container in which the sealed source is located;
- (b) The identity of the radiographer to whom assigned; and
- (c) The plant or site where used and dates of use.

#### § 34.28 Inspection and maintenance of radiographic exposure devices, storage containers, and source changers.

- (a) The licensee shall check for obvious defects in radiographic exposure devices, storage containers, and source changers prior to use each day the equipment is used.
- (b) The licensee shall conduct a program for inspection and maintenance of radiographic exposure devices, storage containers, and source changers at intervals not to exceed three months or prior to the first use thereafter to assure proper functioning of components important to safety. Records of these inspections and maintenance shall be kept for two years.

#### § 34.29 Permanent radiographic installations.

- (a) Permanent radiographic installations having high radiation area entrance controls of the types described in § 20.203(c) (2)(ii), (2)(iii), or (4) shall also meet the following special requirement.
- (b) Each entrance that is used for personnel access to the high radiation area in a permanent radiographic installation to which this section applies shall have both visible and audible warning signals to warn of the presence of radiation. The visible signal shall be actuated by radiation whenever the

source is exposed. The audible signal shall be actuated when an attempt is made to enter the installation while the source is exposed.

(c) The alarm system shall be tested at intervals not to exceed three months or prior to the first use thereafter of the source in the installation. Records of the tests shall be kept for two years.

### PERSONAL RADIATION SAFETY REQUIREMENTS FOR RADIOGRAPHERS AND RADIOGRAPHERS' ASSISTANTS

#### § 34.31 Training.

(a) The licensee shall not permit any individual to act as a radiographer until such individual:

(1) Has been instructed in the subjects outlined in Appendix A of this part:

(2) Has received copies of and instruction in NRC regulations contained in this part and in the applicable sections of Parts 19 and 20 of this chapter, NRC license(s) under which the radiographer will perform radiography, and the licensee's operating and emergency procedures;

(3) Has demonstrated competence to use the licensee's radiographic exposure devices, sealed sources, related handling tools, and survey instruments; and

(4) Has demonstrated understanding of the instructions in this paragraph (a) by successful completion of a written test and a field examination on the subjects covered.

(b) The licensee shall not permit any individual to act as a radiographer's assistant until such individual:

(1) Has received copies of and instruction in the licensee's operating and emergency procedures;

(2) Has demonstrated competence to use, under the personal supervision of the radiographer, the radiographic exposure devices, sealed sources, related handling tools, and radiation survey instruments that the assistant will use; and

(3) Has demonstrated understanding of the instructions in this paragraph (b) by successfully completing a written or oral test and a field examination on the subjects covered.

(c) Records of the above training, including copies of written tests and dates of oral tests and field examinations, shall be maintained for three years.



§ 34.22 Operating and emergency procedures.

The licensee's operating and emergency procedures shall include instructions in at least the following:

(a) The handling and use of licensed sealed sources and radiographic exposure devices to be employed such that no person is likely to be exposed to radiation doses in excess of the limits established in Part 30 of this chapter "Standards for Protection Against Radiation";

(b) Methods and occasions for conducting radiation surveys;

(c) Methods for controlling access to radiographic areas;

(d) Methods and occasions for locking and securing radiographic exposure devices, storage containers and sealed sources;

(e) Personnel monitoring and the use of personnel monitoring equipment;

(f) Transporting sealed sources to field locations, including packing of radiographic exposure devices and storage containers in the vehicles, posting of vehicles and control of the sealed sources during transportation;

(g) Minimizing exposure of persons in the event of an accident;

(h) The procedure for notifying proper persons in the event of an accident; and

(i) Maintenance of records.

(j) The inspection and maintenance of radiographic exposure devices and storage containers.

(k) Steps that must be taken immediately by radiography personnel in the event a pocket dosimeter is found to be off-scale.

(l) The procedure(s) for identifying and reporting defects and noncompliance, as required by Part 21 of this chapter.

§ 34.23 Personnel monitoring.

(a) The licensee shall not permit any individual to act as a radiographer or a radiographer's assistant unless, at all times during radiographic operations, each such individual wears a direct reading pocket dosimeter and either a film badge or a thermoluminescent dosimeter (TLD). Pocket dosimeters shall have a range from zero to at least 300 milliroentgens and shall be recharged at the start of each shift. Each film badge and TLD shall be assigned to and worn by only one individual.

(b) Pocket dosimeters shall be read and exposures recorded daily.

(c) Pocket dosimeters shall be checked at periods not to exceed one year for correct response to radiation. Acceptable dosimeters shall read within plus or minus 30 percent of the true radiation exposure.

(d) If an individual's pocket dosimeter is discharged beyond its range, his film badge or TLD shall be immediately sent for processing.

(e) Reports received from the film badge or TLD processor shall be kept for inspection until the Commission authorizes their disposal. Records of daily pocket dosimeter readings shall be kept for two years.

PRECAUTIONARY PROCEDURES IN RADIOGRAPHIC OPERATIONS

§ 34.41 Security.

During each radiographic operation the radiographer or radiographer's assistant shall maintain a direct surveillance of the operation to protect against unauthorized entry into a high radiation area, as defined in Part 30 of this chapter, except (a) where the high radiation area is equipped with a control device or an alarm system as described in § 20.203(c)(2) of this chapter, or (b) where the high radiation area is locked to protect against unauthorized or accidental entry.

§ 34.42 Posting.

Notwithstanding any provisions in § 20.204(c) of this chapter, areas in which radiography is being performed shall be conspicuously posted as required by § 20.203(b) and (c)(1) of this chapter.

§ 34.43 Radiation surveys.

The licensee shall ensure that:

(a) At least one calibrated and operable radiation survey instrument is available at the location of its radiographic operations whenever radiographic operations are being performed, and at the storage area, as defined in § 34.2, whenever a radiographic exposure device, a storage container, or source is being placed in storage.

(b) A survey with a calibrated and operable radiation survey instrument is made after each exposure to determine that the sealed source has been returned to its shielded position. The entire circumference of the radiographic exposure device must be surveyed. If the radiographic exposure device has a source guide tube, the survey must include the guide tube.

(c) A survey with a calibrated and operable radiation survey instrument is made at any time a radiographic exposure device is placed in a storage area, as defined in § 34.2, to determine

that the sealed source is in its shielded position. The entire circumference of the radiographic exposure device must be surveyed.

(d) A record of the storage survey required in paragraph (c) is made and is retained for three years when that storage survey is the last one performed in the work day.

§ 34.44 Supervision of radiographer's assistants.

Whenever a radiographer's assistant uses radiographic exposure devices, uses sealed sources or related source handling tools, or conducts radiation surveys required by § 34.43(b) to determine that the sealed source has returned to the shielded position after an exposure, he shall be under the personal supervision of a radiographer. The personal supervision shall include: (a) The radiographer's personal presence at the site where the sealed sources are being used, (b) the ability of the radiographer to give immediate assistance if required, and (c) the radiographer's watching the assistant's performance of the operations referred to in this section.

EXEMPTIONS

§ 34.51 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.

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- B. Units of radiation dose (mrem) and quantity of radioactivity (curie).
- C. Hazards of exposure to radiation.
- D. Levels of radiation from licensed material.
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  2. Calibration.
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- B. Radiographic exposure devices.
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V. CASE HISTORIES OF RADIOGRAPHY ACCIDENTS

[Note removed 49 FR 19623]

41 FR 10005

30 FR 8185

35 FR 17397

44 FR 50805

42 FR 11689

51 FR 21736

44 FR 50805



UNITED STATES NUCLEAR REGULATORY COMMISSION  
RULES and REGULATIONS

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

71.0

71.0(c)

**PART  
71**

**PACKAGING AND TRANSPORTATION OF RADIOACTIVE MATERIAL**

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Authority: Stat. 20, 87, 92, 93, 95, 101, 102,  
103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116,  
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**Subpart A—General Provisions**

§ 71.0 Purpose and scope.

(a) This part establishes: (1) requirements for packaging, preparation for shipment, and transportation of licensed material; and (2) procedures and standards for NRC approval of packaging and shipping procedures for fissile material and for a quantity of other licensed material in excess of a Type A quantity.

(b) The packaging and transport of licensed material are also subject to other parts of this chapter (e.g., Parts 20, 21, 30, 39, 40, 70, and 73) and to the regulations of other agencies (e.g., the U.S. Department of Transportation (DOT) and the U.S. Postal Service (USPS) <sup>1</sup>) having jurisdiction over means of transport. The requirements of this part are in addition to, and not in substitution for, other requirements.

(c) The regulations in this part apply to any licensee authorized by specific license issued by the Commission to receive, possess, use, or transfer licensed material if the licensee delivers that material to a carrier for transport or transports the material outside the confines of the licensee's facility, plant.

<sup>1</sup> Postal Service Manual (Domestic Mail Manual), section 124.3, which is incorporated by reference at 39 CFR 111.1 (1974).

or other authorized place of use. No provision of this part authorizes possession of licensed material.

(d) Exemptions from the requirement for license in § 71.3 are specified in § 71.10. General licenses for which no NRC package approval is required are issued in §§ 71.14-71.24. The general license in § 71.12 requires that an NRC certificate of compliance or other package approval be issued for the package to be used under the general license. Application for package approval must be completed in accordance with Subpart D of this part, demonstrating that the design of the package to be used satisfies the package approval standards contained in Subpart E of this part as related to the tests of Subpart F of this part. The transport of licensed material or delivery of licensed material to a carrier for transport is subject to the operating controls and procedures requirements of Subpart G of this part, to the quality assurance requirements of Subpart H of this part, and to the general provisions of Subpart A of this part, including DOT regulations referenced in § 71.5.

#### § 71.1 Communications.

All communications concerning the regulations in this part should be addressed to the Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555, or may be delivered in person at the Commission offices at 1717 H Street, NW., Washington, DC, or its offices at 7915 Eastern Avenue, Silver Spring, Maryland.

#### § 71.2 Interpretations.

Only written interpretations of the regulations in this part by the Commission's General Counsel are binding upon the Commission.

#### § 71.3 Requirement for license.

A licensee subject to the regulations in this part may not (a) deliver any licensed material to a carrier for transport or (b) transport licensed material except as authorized in a general license or a specific license issued by the Commission, or as exempted in this part.

#### § 71.4 Definitions.

The following terms are as defined here for the purpose of this part. Throughout this part, the standards are expressed in metric units; the approximate English equivalents presented in parentheses are for information only.

*A<sub>1</sub>* means the maximum activity of special form radioactive material permitted in a Type A package. *A<sub>2</sub>* means the maximum activity of radioactive material, other than special

form radioactive material, permitted in a Type A package. These values are either listed in Appendix A of this part, Table A-1, or may be derived in accordance with the procedure prescribed in Appendix A of this part.

*Carrier* means a person engaged in the transportation of passengers or property by land or water as a common, contract, or private carrier, or by civil aircraft.

*Close reflection by water* means immediate contact by water of sufficient thickness for maximum reflection of neutrons.

*Containment system* means the components of the packaging intended to retain the radioactive material during transport.

*Conveyance* means any vehicle, aircraft, vessel, freight container, or hold, compartment, or defined deck area of an inland waterway craft or seagoing vessel.

*Exclusive use* (also referred to in other regulations as "sole use" or "full load") means the sole use of a conveyance by a single consignor and for which all initial, intermediate, and final loading and unloading are carried out in accordance with the direction of the consignor or consignee.

*Fissile classification* means the categorization of fissile material packages into one of the following three classes according to the controls needed to provide nuclear criticality safety during transportation:

(1) *Fissile Class I*: A package which may be transported in unlimited numbers and in any arrangement, and which requires no nuclear criticality safety controls during transportation. A transport index is not assigned for purposes of nuclear criticality safety but may be required because of external radiation levels.

(2) *Fissile Class II*: A package which may be transported together with other packages in any arrangement but, for criticality control, in numbers which do not exceed an aggregate transport index of 50. These shipments require no other nuclear criticality safety control during transportation. Individual packages may have a transport index not less than 0.1 and not more than 10.

(3) *Fissile Class III*: A shipment of packages which is controlled in transportation by specific arrangements between the shipper and the carrier to provide nuclear criticality safety.

*Fissile material and fissile radionuclides*: "Fissile material" means any material consisting of or containing one or more fissile radionuclides. Fissile radionuclides are plutonium-238, plutonium-239, plutonium-241, uranium-233, and uranium-235. Neither natural nor depleted uranium is fissile material.

Fissile materials are classified in this section according to the controls needed

to provide nuclear criticality safety during transportation. Certain exclusions are provided in § 71.53.

*Low specific activity material* means any of the following:

(1) Uranium or thorium ores and physical or chemical concentrates of those ores;

(2) Unirradiated natural or depleted uranium or unirradiated natural thorium;

(3) Tritium oxide in aqueous solutions provided the concentration does not exceed 5.0 millicuries per milliliter;

(4) Material in which the radioactivity is essentially uniformly distributed and in which the estimated average concentration per gram of contents does not exceed:

(i) 0.0001 millicurie of radionuclides for which the *A<sub>2</sub>* quantity in Appendix A of this part is not more than 0.05 curie;

(ii) 0.005 millicurie of radionuclides for which the *A<sub>2</sub>* quantity in Appendix A of this part is more than 0.05 curie, but not more than 1 curie; or

(iii) 0.3 millicurie of radionuclides for which the *A<sub>2</sub>* quantity in Appendix A of this part is more than 1 curie.

(5) Objects of nonradioactive material externally contaminated with radioactive material, provided that the radioactive material is not readily dispersible and the surface contamination, when averaged over an area of 1 square meter, does not exceed 0.0001 millicurie (220,000 disintegrations per minute) per square centimeter of radionuclides for which the *A<sub>2</sub>* quantity in Appendix A of Part 71 is not more than 0.05 curie, or 0.001 millicurie (2,200,000 disintegrations per minute) per square centimeter for other radionuclides.

*Maximum normal operating pressure* means the maximum gauge pressure that would develop in the containment system in a period of one year under the heat test specified in § 71.71(c)(1), in the absence of venting, external cooling by an ancillary system, or operational controls during transport.

*Natural thorium* means thorium with the naturally occurring distribution of thorium isotopes (essentially 100 weight percent thorium-232).

*Normal form radioactive material* means radioactive material which has not been demonstrated to qualify as "special form radioactive material."

*Optimum interspersed hydrogenous moderation* means the presence of hydrogenous material between packages to such an extent that the maximum nuclear reactivity results.

*Package* means the packaging together with its radioactive contents as presented for transport.

(1) *Fissile material package* means a fissile material packaging together with its fissile contents.



(2) *Type B package* means a Type B package together with its radioactive contents. On approval, a Type B package design is designated by NRC as B(U) unless the package has a maximum normal operating pressure of more than 700 kilopascal (100 lb/in<sup>2</sup>) gauge or a pressure relief device which would allow the release of radioactive material to the environment under the tests specified in § 71.73 (hypothetical accident conditions), in which case it will receive a designation B(M). B(U) refers to the need for unilateral approval of international shipments; B(M) refers to the need for multilateral approval. There is no distinction made in how packages with these designations may be used in domestic transportation. To determine their distinction for international transportation, see DOT regulations in 49 CFR Part 173. A Type B package approved prior to September 8, 1983, was designated only as Type B. Limitations on its use are specified in § 71.13.

*Packaging* means the assembly of components necessary to ensure compliance with the packaging requirements of this part. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The vehicle, tie-down system, and auxiliary equipment may be designated as part of the packaging.

*Special form radioactive material* means radioactive material which satisfies the following conditions:

(1) It is either a single solid piece or is contained in a sealed capsule that can be opened only by destroying the capsule;

(2) The piece or capsule has at least one dimension not less than 5 millimeters (0.197 inch); and

(3) It satisfies the test requirements of § 71.75.

A special form encapsulation designed in accordance with the requirements of § 71.6(o) of this part in effect on June 30, 1983, and constructed prior to July 1, 1985 may continue to be used. A special form encapsulation either designed or constructed after June 30, 1985 must meet requirements of this paragraph applicable at the time of its design or construction.

*Specific activity* of a radionuclide means the radioactivity of the radionuclide per unit mass of that nuclide. The specific activity of a material in which the radionuclide is essentially uniformly distributed is the radioactivity per unit mass of the material.

*State* means the several States of the Union, the District of Columbia, the Commonwealth of Puerto Rico, the

Virgin Islands, Guam, American Samoa, the Trust Territory of the Pacific Islands, and the Commonwealth of the Northern Mariana Islands.

*Transport index* means the dimensionless number (rounded up to the first decimal place) placed on the label of a package to designate the degree of control to be exercised by the carrier during transportation. The transport index is determined as follows:

(1) The number expressing the maximum radiation level in millirem per hour at 1 meter from the external surface of the package; or

(2) For Fissile Class II packages, the number expressing the maximum radiation level in millirem per hour at 1 meter from the external surface of the package, or the number obtained by dividing 50 by the allowable number of the packages which may be transported together as determined under § 71.59, whichever number is larger.

*Type A quantity* means a quantity of radioactive material, the aggregate radioactivity of which does not exceed  $A_1$  for special form radioactive material or  $A_2$  for normal form radioactive material, where  $A_1$  and  $A_2$  are given in Appendix A of this part or may be determined by procedures described in Appendix A of this part.

*Type B quantity* means a quantity of radioactive material greater than a Type A quantity.

*Uranium—natural depleted enriched*

(1) *Natural uranium* means uranium with the naturally occurring distribution of uranium isotopes (approximately 0.711 weight percent uranium-235, and the remainder essentially uranium-238).

(2) *Depleted uranium* means uranium containing less uranium-235 than the naturally occurring distribution of uranium isotopes.

(3) *Enriched uranium* means uranium containing more uranium-235 than the naturally occurring distribution of uranium isotopes.

#### § 71.5 Transportation of licensed material.

(a) Each licensee who transports licensed material outside of the confines of its plant or other place of use, or who delivers licensed material to a carrier for transport, shall comply with the applicable requirements of the regulations appropriate to the mode of transport of DOT in 49 CFR Parts 170 through 189.

(1) The licensee shall particularly note DOT regulations in the following areas:

(i) Packaging—49 CFR Part 173, Subparts A and B and §§ 173.401–173.478.

(ii) Marking and labeling—49 CFR Part 172, Subpart D and §§ 172.400–172.407; 172.436–172.440.

(iii) Placarding—49 CFR Part 172.500–172.519; 172.556 and Appendices B and C.

(iv) Monitoring—49 CFR Part 172, Subpart C.

(v) Accident reporting—49 CFR Part 171.15 and 171.16.

(vi) Shipping papers—49 CFR Part 172, Subpart C.

(2) The licensee shall also note DOT regulations pertaining to the following modes of transportation:

(i) Rail—49 CFR Part 174, Subparts A–D and K.

(ii) Air—49 CFR Part 176, Subparts A–D and M.

(iii) Vessel—49 CFR Part 176, Subparts A–D and M.

(iv) Public Highway—49 CFR Part 177.

(b) If DOT regulations are not applicable to a shipment of licensed material by rail, highway, or water because the shipment or the transportation of the shipment is not in interstate or foreign commerce, or to a shipment of licensed material by air because the shipment is not transported in civil aircraft, the licensee shall conform to the standards and requirements of the DOT specified in paragraph (a) of this section to the same extent as if the shipment or transportation were in interstate or foreign commerce or in civil aircraft. A request for modification, waiver, or exemption from those requirements, and any notification referred to in those requirements, must be filed with or made to the Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555.

#### § 71.6 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 3150-0006.

(b) The approved information collection requirements contained in this part appear in §§ 71.5, 71.12, 71.31, 71.33, 71.35, 71.37, 71.65, 71.87, 71.89, 71.91, 71.93, 71.95, 71.97, 71.101, 71.103, 71.105, 71.107, 71.109, 71.111, 71.115, 71.115, 71.117, 71.119, 71.121, 71.123, 71.125, 71.127, 71.129, 71.131, 71.133, 71.135, and 71.137.



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§ 71.6a **Completeness and accuracy of information.**

(a) Information provided to the Commission by an applicant for a license or by a licensee of information required by statute or by the Commission's regulations, orders, or license conditions to be maintained by the applicant or the licensee shall be complete and accurate in all material respects.

(b) Each applicant or licensee shall notify the Commission of information identified by the applicant or licensee as having for the regulated activity a significant implication for public health and safety or common defense and security. An applicant or licensee violates this paragraph only if the applicant or licensee fails to notify the Commission of information that the applicant or licensee has identified as having a significant implication for public health and safety or common defense and security. Notification shall be provided to the Administrator of the appropriate Regional Office within two working days of identifying the information. This requirement is not applicable to information which is already required to be provided to the Commission by a State, a commonwealth, or a territory.

52 FR 49362

48 FR 35600

**Subpart B—Exemptions****§ 71.7 Specific exemptions.**

On application of any interested person or on its own initiative, the Commission may grant any exemption from the requirements of the regulations in this part that it determines is authorized by law and will not endanger life or property or the common defense and security.

**§ 71.8 (Reserved)****§ 71.9 Exemption of physicians.**

Any physician licensed by a State of the United States to dispense drugs in the practice of medicine is exempt from § 71.5 with respect to transport by the physician of licensed material for use in the practice of medicine. However, any physician operating under this exemption must be licensed under 10 CFR Part 35.

**§ 71.10 Exemption for low level materials.**

(a) A licensee is exempt from all requirements of this part with respect to shipment or carriage of a package containing radioactive material having a specific activity not greater than 0.002

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microcurie/gram.

(b) A licensee is exempt from all requirements of this part, other than § 71.5 and § 71.85, with respect to shipment or carriage of the following packages:

(1) A package containing no more than a Type A quantity of radioactive material if the package contains no fissile material or if the fissile material exemption standards of § 71.83 are satisfied; or

(2) A package transported between locations within the United States which contains only americium or plutonium in special form with an aggregate radioactivity not to exceed 20 curies, if the package contains no fissile material or if the fissile material exemption standards of § 71.83 are satisfied.

§ 71.11 (Reserved)

## Subpart C—General Licenses

§ 71.12 General license: NRC approved package.

(a) A general license is hereby issued to any licensee of the Commission to transport, or to deliver to a carrier for transport, licensed material in a package for which a license, certificate of compliance, or other approval has been issued by the NRC.

(b) This general license applies only to a licensee who has a quality assurance program approved by the Commission as satisfying the provisions of Subpart H of this part.

(c) This general license applies only to a licensee who:

(1) Has a copy of the specific license, certificate of compliance, or other approval of the package and has the drawings and other documents referenced in the approval relating to the use and maintenance of the packaging and to the actions to be taken prior to shipment;

(2) Complies with the terms and conditions of the license, certificate, or other approval, as applicable, and the applicable requirements of Subparts A, C, and H of this part; and

(3) Submits in writing to the Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555, prior to the licensee's first use of the package, the licensee's name and license number and the package identification number specified in the package approval.

(d) This general license applies only when the package approval authorizes use of the package under this general license.

(e) For previously approved Type B packages which are not designated as either B(U) or B(M) in the NRC Certificate of Compliance, this general license is subject to the additional restrictions of § 71.13.

§ 71.13 Previously approved Type B package.

(a) A Type B package previously approved by the NRC, but not designated as B(U) or B(M) in the NRC Certificate of Compliance, may be used under the general license of § 71.12 with the following additional limitations:

(1) Fabrication of the packaging was satisfactorily completed before August 31, 1966, as demonstrated by application of its model number in accordance with § 71.85(c); and

(2) The package may not be used for a shipment to a location outside the United States after August 31, 1986, except under special arrangement approved by DOT in accordance with 49 CFR 173.471.

(b) The NRC will approve modifications to the design and authorized contents of a Type B package previously approved by the NRC, but not designated as B(U) or B(M) in the NRC Certificate of Compliance, provided:

(1) The modifications are not significant with respect to the design, operating characteristics, or safe performance of the containment system when the package is subjected to the tests specified in §§ 71.71 and 71.73; and

(2) The modification to the package satisfies the requirements of this part.

(c) The NRC will revise the package identification number to designate previously approved Type B package designs as B(U) or B(M) after receipt of an application demonstrating that the design meets the requirements of this part.

§ 71.14 General license: DOT specification container.

(a) A general license is issued to any licensee of the Commission to transport or to deliver to a carrier for transport licensed material in a specification container for fissile material or for a Type B quantity of radioactive material as specified in the regulations of DOT in 49 CFR Parts 173 and 178.

(b) This general license applies only to a licensee who has a quality assurance program approved by the Commission as satisfying the provisions of Subpart H of this part.

(c) This general license applies only to a licensee who:

(1) Has a copy of the specification; and

(2) Complies with the terms and conditions of the specification and the applicable requirements of Subparts A,

C, and H of this part.

(d) This general license is subject to the limitation that the specification container may not be used for a shipment to a location outside the United States after August 31, 1986, except under special arrangements approved by DOT in accordance with 49 CFR 173.472.

§ 71.15 General license: Use of foreign approved package.

(a) A general license is issued to any licensee of the Commission to transport or to deliver to a carrier for transport licensed material in a package the design of which has been approved in a foreign national competent authority certificate which has been revalidated by DOT as meeting the applicable requirements of 49 CFR 171.12.

(b) This general license applies only to shipments made to or from locations outside the United States.

(c) This general license applies only to a licensee who:

(1) Has a copy of the applicable certificate, the revalidation, and the drawings and other documents referenced in the certificate relating to the use and maintenance of the packaging and to the actions to be taken prior to shipment; and

(2) Complies with the terms and conditions of the certificate and revalidation and with the applicable requirements of Subparts A, C, and H of this part. With respect to the quality assurance provisions of Subpart H of this part, the licensee is exempt from design, construction, and fabrication considerations.

§ 71.16 General license: Type A, Fissile Class II package.

(a) A general license is issued to any licensee of the Commission to transport fissile material, or to deliver fissile material to a carrier for transport, without complying with the package standards of Subparts E and F of this part if the material is shipped as a Fissile Class II package.

(b) This general license applies only when a package contains no more than a Type A quantity of radioactive material, including only one of the following:

- (1) Up to 40 grams of uranium-235; or
- (2) Up to 30 grams of uranium-233; or
- (3) Up to 25 grams of the fissile radionuclides of plutonium, except that for encapsulated plutonium-beryllium neutron sources in special form, an  $A_1$  quantity of plutonium may be present; or
- (4) A combination of fissile radionuclides in which the sum of the ratios of the amount of each radionuclide to the corresponding



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maximum amounts in paragraphs (b) (1), (2), and (3) of this section does not exceed unity.

(c) This general license applies only when, except as specified below for encapsulated plutonium-beryllium sources, a package containing more than 15 grams of fissile radionuclides is labeled with a transport index not less than the number given by the following equation, where the package contains x grams of uranium-235, y grams of uranium-233 and z grams of the fissile radionuclides of plutonium:

$$\text{Minimum Transport Index} = (0.40x + 0.67y + z) \left(1 - \frac{15}{x + y + z}\right)$$

For a package in which the only fissile material is in the form of encapsulated plutonium-beryllium neutron sources in special form, the transport index based on criticality considerations may be taken as 0.026 times the number of grams of the fissile radionuclides of plutonium in excess of 15 grams. In all cases, the transport index must be rounded up to one decimal place, and may not exceed 10.0.

**§ 71.20 General license: Restricted, Fissile Class II package.**

(a) A general license is issued to any licensee of the Commission to transport fissile material, or to deliver fissile material to a carrier for transport, without complying with the package standards of Subparts E and F of this part if the material is shipped as a Fissile Class II package.

(b) This general license applies only when:

- (1) The package contains no more than a Type A quantity of radioactive material; and
- (2) Neither beryllium nor hydrogenous material enriched in deuterium is present; and
- (3) The total mass of graphite present does not exceed 150 times the total mass of uranium-235 plus plutonium; and
- (4) Substances having a higher hydrogen density than water, e.g., certain hydrocarbon oils, are not present, except that polyethylene may be used for packing or wrapping; and
- (5) Uranium-233 is not present, and the amount of plutonium does not exceed 1% of the amount of uranium-235; and

(6) The amount of uranium-235 is limited as follows:

- (i) If the fissile radionuclides are not uniformly distributed, the maximum amount of uranium-235 per package may not exceed the value given in Table I of this part; or
- (ii) If the fissile radionuclides are distributed uniformly (i.e., cannot form a lattice arrangement within the

packaging) the maximum amount of uranium-235 per package may not exceed the value given in Table II of this part; and

(7) The transport index of each package based on criticality considerations is taken as 10 times the number of grams of uranium-235 in the package divided by the maximum allowable number of grams per package in accordance with Table I or Table II of this part as applicable.

**TABLE I.—PERMISSIBLE MASS OF URANIUM-235 PER FISSILE CLASS II PACKAGE APPLICABLE TO § 71.20(b)(6)(i)**

(Nonuniform distribution)	
Uranium enrichment in weight percent of uranium-235 not exceeding	Permissible maximum grams of uranium-235 per package
24	40
20	42
15	45
11	48
10	51
8.5	52
8	54
6.5	56
6	57
7.5	59
7	60
6.5	62
6	65
5.5	68
5	72
4.5	76
4	80
3.5	85
3	100
2.5	120
2	150
1.5	272
1.25	350
1	680
0.85	1,200

**TABLE II.—PERMISSIBLE MASS OF URANIUM-235 PER FISSILE CLASS II PACKAGE APPLICABLE TO § 71.20(b)(6)(ii)**

(Uniform distribution)	
Uranium enrichment in weight percent of uranium-235 not exceeding	Permissible maximum grams of uranium-235 per package
4	84
3.5	88
3	112
2.5	140
2	240
1.5	350
1.25	600

**§ 71.22 General license: Type A package, Fissile Class III shipment.**

(a) A general license is issued to any licensee of the Commission to transport fissile material, or to deliver fissile material to a carrier for transport, without complying with the package standards of Subparts E and F of this part if limited material is shipped as a Fissile Class III shipment.

(b) This general license applies only when a package contains no more than a Type A quantity of radioactive material and no more than 400 grams total of the fissile radionuclides of plutonium encapsulated as plutonium-beryllium neutron sources in special form.

(c) This general license applies only when the fissile radionuclides in the Fissile Class III shipment exceeds none of the following:

- (1) 500 grams of uranium-235; or
- (2) 300 grams total of uranium-235, and the fissile radionuclides of plutonium; or
- (3) A total quantity of uranium-233, uranium-235, and the fissile radionuclides of plutonium such that the sum of the ratios of the quantity of each radionuclide to the quantity specified in paragraphs (c)(1) and (c)(2) of this section exceeds unity; or
- (4) 2500 grams total of the fissile radionuclides of plutonium encapsulated as plutonium-beryllium neutron sources in special form.

(d) This general license applies only when shipment of these packages is made under procedures specifically authorized by DOT in accordance with 49 CFR Part 173 of its regulations to prevent loading, transport or storage of these packages with other Fissile Class II packages or Fissile Class III shipments.

**§ 71.24 General license: Restricted, Fissile Class III shipment.**

(a) A general license is issued to any licensee of the Commission to transport fissile material, or to deliver fissile material to a carrier for transport, without complying with the package standards of Subparts E and F of this part if limited material is shipped as a Fissile Class III shipment.

(b) This general license applies only when:

- (1) No package contains more than a Type A quantity of radioactive material; and
- (2) The packaging does not incorporate lead shielding exceeding 5 cm in thickness, tungsten shielding, or uranium shielding; and
- (3) Neither beryllium nor hydrogenous material enriched in deuterium is present; and



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(4) The total mass of graphite present does not exceed 180 times the total mass of uranium-235 and plutonium; and

(5) Substances having a higher hydrogen density than water, e.g., certain hydrocarbon oils, are not present, except that polyethylene may be used for packing or wrapping; and

(6) For fissile contents containing uranium-235 and less than 1% total plutonium:

(i) If the fissile radionuclides are not uniformly distributed, the maximum amount of uranium-235 per consignment does not exceed the value given in Table III of this part; or

(ii) If the fissile radionuclides are distributed uniformly and cannot form a lattice arrangement within the packaging, the maximum amount of uranium-235 per shipment does not exceed the value given in Table IV of this part; and

(7) For fissile contents containing uranium-235 or more than 1% plutonium, the total mass of fissile material per shipment is limited so that the sum of the number of grams of uranium-235 divided by 400, the number of grams of plutonium divided by 225, and the number of grams of uranium-235 divided by 250 does not exceed unity as expressed in the formula

$$\frac{\text{grams uranium-235}}{400 \text{ grams}} + \frac{\text{grams plutonium}}{225 \text{ grams}} \leq 1 \text{ and}$$

$$\frac{\text{grams uranium-235}}{250 \text{ grams}} \leq 1 \text{ and}$$

(8) The transport must be direct to the consignee without any intermediate transit storage; and

(9) Shipment of these packages is made under procedures specifically authorized by DOT in accordance with 49 CFR Part 173 of its regulations to prevent loading, transport or storage of these packages with other Fissile Class II packages or Fissile Class III shipments.

TABLE III—PERMISSIBLE MASS OF URANIUM-235 PER FISSILE CLASS II SHIPMENT APPLICABLE TO § 71.24(D)(6)(i)

(Uniform distribution)

Uranium enrichment in weight percent of uranium-235 not exceeding	Permissible maximum grams of uranium-235 per consignment
20	600
15	600
11	600
10	600
9.5	600
9	675
8.5	600
8	710
7.5	750
7	750
6.5	780
6	810
5.5	850
5	880
4.5	920
4	1,000
3.5	1,100
3	1,200
2.5	1,500
2	2,000
1.5	3,000
1.25	4,000
1	5,000
0.85	15,000

TABLE IV—PERMISSIBLE MASS OF URANIUM-235 PER FISSILE CLASS III SHIPMENT APPLICABLE TO § 71.24(D)(6)(ii)

(Uniform distribution)

Uranium enrichment in weight percent of uranium-235 not exceeding	Permissible maximum grams of uranium-235 per consignment
4	1,000
3.5	1,100
3	1,400
2.5	1,800
2	3,000
1.5	7,000
1.25	10,000

#### Subpart D—Application for Package Approval

##### § 71.31 Contents of application.

(a) An application for an approval under this part must include, for each proposed packaging design, the following information:

- (1) A package description as required by § 71.33;
- (2) A package evaluation as required by § 71.35;

(3) A quality assurance program description as required by § 71.37;

(4) In the case of fissile material, an identification of the proposed fissile class.

(b) Except as provided in § 71.33, an application for modification of a package design, whether for modification of the packaging or authorized contents, must include sufficient information to demonstrate that the proposed design satisfies the package standards in effect at the time the application is filed.

##### § 71.33 Package description.

The application must include a description of the proposed package in sufficient detail to identify the package accurately and provide a sufficient basis for evaluation of the package. The description must include:

- (a) With respect to the packaging:
  - (1) Classification as Type B(U), Type B(M), or fissile material packaging;
  - (2) Gross weight;
  - (3) Model number;
  - (4) Identification of the containment system;
  - (5) Specific materials of construction, weights, dimensions, and fabrication methods of:
    - (i) Receptacles;
    - (ii) Materials specifically used as nonfissile neutron absorbers or moderators;
    - (iii) Internal and external structures supporting or protecting receptacles;
    - (iv) Valves, sampling ports, lifting devices, and tie-down devices;
    - (v) Structural and mechanical means for the transfer and dissipation of heat; and
- (6) Identification and volumes of any receptacles containing coolant.

(b) With respect to the contents of the package:

- (1) Identification and maximum radioactivity of radioactive constituents;
- (2) Identification and maximum quantities of fissile constituents;
- (3) Chemical and physical form;
- (4) Extent of reflection, the amount and identity of nonfissile materials used as neutron absorbers or moderators, and the atomic ratio of moderator to fissile constituents;
- (5) Maximum normal operating pressure;
- (6) Maximum weight;
- (7) Maximum amount of decay heat; and
- (8) Identification and volumes of any coolants.

##### § 71.35 Package evaluation.

The application must include:

- (a) A demonstration that the package satisfies the standards specified in Subparts E and F of this part;

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(b) For a Fissile Class II package, the allowable number of packages which may be transported in the same vehicle in accordance with § 71.59; and

(c) For a Fissile Class III shipment, any proposed special controls and precautions for transport, loading, unloading, and handling, and any proposed special controls in the event of accident or delay.

#### § 71.57 Quality assurance.

(a) The applicant shall describe the quality assurance program (see Subpart H of this part) for the design, fabrication, assembly, testing, maintenance, repair, modification, and use of the proposed package.

(b) The applicant shall identify any established codes and standards proposed for use in package design, fabrication, assembly, testing, maintenance, and use. In the absence of any codes and standards, the applicant shall describe the basis and rationale used to formulate the package quality assurance program.

(c) The applicant shall identify any specific provisions of the quality assurance program which are applicable to the particular package design under consideration, including a description of the leak testing procedures.

#### § 71.59 Requirement for additional information.

The Commission may at any time require additional information in order to enable it to determine whether a license, certificate of compliance, or other approval should be granted, denied, modified, suspended, or revoked.

### Subpart E—Package Approval Standards

#### § 71.61 Demonstration of compliance.

(a) The effects on a package of the tests specified in § 71.71 (Normal Conditions of Transport) and the tests specified in § 71.73 (Hypothetical Accident Conditions) must be evaluated by subjecting a sample package or scale model to test, or by other method of demonstration acceptable to the Commission, as appropriate for the particular feature being considered.

(b) Taking into account the type of vehicle, the method of securing or attaching the package, and the controls to be exercised by the shipper, the Commission may permit the shipment to be evaluated together with the transporting vehicle.

(c) Environmental and test conditions different from those specified in § 71.71 and § 71.73 may be approved by the Commission if the controls proposed to be exercised by the shipper are demonstrated to be adequate to assure the safety of the shipment.

#### § 71.63 General standards for all packages.

(a) The smallest overall dimension of a package must not be less than 10 cm (four in.).

(b) The outside of a package must incorporate a feature, such as a seal, which is not readily breakable, and which, while intact, would be evidence that the package has not been opened by unauthorized persons.

(c) Each package must include a containment system securely closed by a positive fastening device which cannot be opened unintentionally.

(d) A package must be of materials and construction which assure that there will be no significant chemical, galvanic, or other reaction among the packaging components or between the packaging components and the package contents, including possible reaction resulting from inleakage of water to the maximum credible extent.

(e) A package valve or other device, the failure of which would allow radioactive contents to escape, must be protected against unauthorized operation and, except for a pressure relief device, must be provided with an enclosure to retain any leakage.

(f) A package must be designed, constructed, and prepared for shipment so that under the tests specified in § 71.71 (Normal Conditions of Transport) there would be no loss or dispersal of radioactive contents, no significant increase in external radiation levels, and no substantial reduction in the effectiveness of the packaging.

(g) A package must be designed, constructed, and prepared for transport so that in still air at 38°C (100°F) and in the shade, no accessible surface of a package would have a temperature exceeding 50°C (122°F) in a non-exclusive use shipment or 82°C (180°F) in an exclusive use shipment.

(h) A package must not incorporate a feature which is intended to allow continuous venting during transport.

#### § 71.65 Lifting and tie-down standards for all packages.

(a) Any lifting attachment that is a structural part of a package must be designed with a minimum safety factor of three against yielding when used to lift the package in the intended manner, and must be designed so that failure of any lifting device under excessive load would not impair the ability of the package to meet other requirements of this subpart. Any other structural part of the package which could be used to lift the package must be capable of being rendered inoperable for lifting the package during transport or must be designed with strength equivalent to that required for lifting attachments.

(b) Tie-down devices:

(1) If there is a system of tie-down devices which is a structural part of the package, the system must be capable of withstanding, without generating stress in any material of the package in excess of its yield strength, a static force applied to the center of gravity of the package having a vertical component of two times the weight of the package with its contents, a horizontal component along the direction in which the vehicle travels of 10 times the weight of the package with its contents, and a horizontal component in the transverse direction of five times the weight of the package with its contents.

(2) Any other structural part of the package which could be used to tie down the package must be capable of being rendered inoperable for tying down the package during transport, or must be designed with strength equivalent to that required for tie-down devices.

(3) Each tie-down device which is a structural part of a package must be designed so that failure of the device under excessive load would not impair the ability of the package to meet other requirements of this part.

#### § 71.47 External radiation standards for all packages.

A package must be designed and prepared for shipment so that the radiation level does not exceed 200 millirem per hour at any point on the external surface of the package and the transport index does not exceed 10 (See § 71.4 "Definitions"). For a package transported as exclusive use by rail, highway, or water, radiation levels external to the package may exceed those limits, but must not exceed any of the following:

(a) 200 millirem/hour on the accessible external surface of the package unless the following conditions are met, in which case the limit is 1000 millirem per hour:

(1) The shipment is made in a closed transport vehicle;

(2) Provisions are made to secure the package so that its position within the vehicle remains fixed during transportation; and

(3) There are no loading or unloading operations between the beginning and end of the transportation;

(b) 200 millirem/hour at any point on the outer surface of the vehicle, including the upper and lower surfaces, or, in the case of an open vehicle, at any point on the vertical planes projected from the outer edges of the vehicle, on the upper surface of the load, and on the lower external surface of the vehicle;

(c) 10 millirem/hour at any point two



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free drop from a height of 0.3 m (one ft.) on each corner or, in the case of a cylindrical Pliable Class II package, onto each of the quarters of each rim.

CRITERIA FOR FREE DROP TEST (WEIGHT/DISTANCE)

Package weight		Free drop distance	
Kilograms	Pounds	Meters	Feet
5 000 or less	11 000	1.2	(4)
5 000 to 10 000	11 000 to 22 000	0.9	(3)
10 000 to 15 000	22 000 to 33 000	0.6	(2)
More than 15 000	More than 33 000	0.3	(1)

(8) *Corner drop.* A free drop onto each corner of the package in succession, or in the case of a cylindrical package onto each quarter of each rim, from a height of 0.3 m (one ft.) onto a flat, essentially unyielding, horizontal surface. This test applies only to fiberboard or wood rectangular packages not exceeding 80 kg (176 pounds) and fiberboard or wood cylindrical packages not exceeding 100 kg (220 pounds).

(9) *Compression.* For packages weighing up to 5000 kg, the package must be subjected, for a period of 24 hours, to a compressive load applied uniformly to the top and bottom of the package in the position in which the package would normally be transported. The compressive load must be the greater of the following:

- (i) The equivalent of five times the weight of the package; or
- (ii) The equivalent of 12.75 kilopascal (1.85 lb/in<sup>2</sup>) multiplied by the vertically projected area of the package.

(10) *Penetration.* Impact of the hemispherical end of a vertical steel cylinder of 3.2 cm (1 1/4 in) diameter and six kg (13 lb) mass, dropped from a height of one m (40 in) onto the exposed surface of the package which is expected to be most vulnerable to puncture. The long axis of the cylinder must be perpendicular to the package surface.

§ 71.73 Hypothetical accident conditions.

(a) *Test procedures.* Evaluation for hypothetical accident conditions is to be based on sequential application of the tests specified in this section, in the order indicated, to determine their cumulative effect on a package or array of packages. An undamaged specimen must be used for the water immersion test specified in paragraph (c)(5) of this section.

(b) *Test conditions.* With respect to the initial conditions for the tests, except for the water immersion tests, to demonstrate compliance with the requirements of this part during testing, the ambient air temperature before and after the tests must remain constant at that value between -20°C (-20°F) and +36°C (100°F) which is most

unfavorable for the feature under consideration. The initial internal pressure within the containment system must be the maximum normal operating pressure unless a lower internal pressure consistent with the ambient temperature assumed to precede and follow the tests is more unfavorable.

(c) *Tests.* Tests for hypothetical accident conditions must be conducted as follows:

(1) *Free Drop.* A free drop of the specimen through a distance of nine m (30 ft) onto a flat, essentially unyielding, horizontal surface, striking the surface in a position for which maximum damage is expected.

(2) *Puncture.* A free drop of the specimen through a distance of one m (40 in) in a position for which maximum damage is expected, onto the upper end of a solid, vertical, cylindrical, mild steel bar mounted on an essentially unyielding, horizontal surface. The bar must be 15 cm (six in) in diameter, with the top horizontal and its edge rounded to a radius of not more than six mm (1/4 in) and of a length as to cause maximum damage to the package, but not less than 20 cm (eight in) long. The long axis of the bar must be vertical.

(3) *Thermal.* Exposure of the whole specimen for not less than 30 minutes to a heat flux not less than that of a radiation environment of 800°C (1475°F) with an emissivity coefficient of at least 0.9. For purposes of calculation, the surface absorptivity must be either that value which the package may be expected to possess if exposed to a fire or 0.8, whichever is greater. In addition, when significant, convective heat input must be included on the basis of still, ambient air at 800°C (1475°F). Artificial cooling must not be applied after cessation of external heat input and any combustion of materials of construction must be allowed to proceed until it terminates naturally. The effects of solar radiation may be neglected prior to, during, and following the test.

(4) *Immersion—fissile material.* For fissile material, in those cases where water leakage has not been assumed for criticality analysis, the specimen must be immersed under a head of water of at least 0.9 m (three ft) for a period of not less than eight hours and in the attitude for which maximum leakage is expected.

(5) *Immersion—all packages.* A separate, undamaged specimen must be subjected to water pressure equivalent to immersion under a head of water of at least 15 m (50 ft) for a period of not less than eight hours. For test purposes, an external pressure of water of 147 kilopascal (21 psi) gauge is considered to meet these conditions.

§ 71.75 Qualification of special form radioactive material.

(a) Evaluation of the contents of a single package for qualification as special form must include a determination of the effect on a specimen of those contents of the tests specified in § 71.77.

(1) Specimens (solid radioactive material or capsules) to be tested must be as normally prepared for loading in a single package, with the radioactive material duplicated as closely as practicable.

(2) A different specimen may be used for each of the tests.

(b) The specimen must not break or shatter when subjected to the impact, percussion, or bending tests.

(c) The specimen must not melt or disperse when subjected to the heat test.

(d) After each test, leak-tightness or indispersibility of the specimen must be determined by a method no less sensitive than the following leaching assessment procedure. For a capsule resistant to corrosion by water, and which has an internal void volume greater than 0.1 milliliters, an alternative to the leaching assessment is a demonstration of leak-tightness of 10<sup>-4</sup> torr-l/s (1.3 × 10<sup>-4</sup> atm cm<sup>3</sup>/s) (based on air at 25°C and one atmosphere differential pressure) for solid radioactive content, or 10<sup>-6</sup> torr-l/s (1.3 × 10<sup>-6</sup> atm cm<sup>3</sup>/s) for liquid or gaseous radioactive content.

(1) The specimen must be immersed for seven days in water at ambient temperature. The water must have a pH of 6-8 and a maximum conductivity of 10 μmho/cm at 20°C (68°F). Encapsulated material is not subject to the seven-day requirement.

(2) The water with specimen must then be heated to a temperature of 50 ± 5°C (122 ± 9°F) and maintained at this temperature for four hours.

(3) The activity of the water must be determined at that time.

(4) The specimen must then be stored for at least seven days in still air of humidity not less than 90% and a temperature not less than 30°C (86°F).

(5) The specimen must then be immersed in water having a pH of 6-8 and a maximum conductivity of 10 μmho/cm at 20°C, and the water with specimen heated to 50 ± 5°C (122 ± 9°F) and maintained at this temperature for four hours.



meters from the vertical planes represented by the outer lateral surfaces of the vehicle, or, in the case of an open vehicle, at any point two meters from the vertical planes projected from the outer edges of the conveyance; and

(d) Two millirem/hour in any normally occupied positions of the vehicle, except that this provision does not apply to private motor carriers when persons occupying these positions are provided with special health supervision, personnel radiation exposure monitoring devices, and training in accordance with § 29.12 of this chapter.

**§ 71.51 Additional requirements for Type B packages.**

(a) A Type B package, in addition to satisfying the requirements of §§ 71.41-71.47 must be designed, constructed, and prepared for shipment so that under the tests specified in:

(1) Section 71.71 (Normal Conditions of Transport), there would be no loss or dispersal of radioactive contents, as demonstrated to a sensitivity of  $10^{-6}$  A<sub>2</sub> per hour, no significant increase in external radiation levels, and no substantial reduction in the effectiveness of the packaging; and

(2) Section 71.73 (Hypothetical Accident Conditions), there would be no escape of krypton-85 exceeding 10,000 curies in one week, no escape of other radioactive material exceeding a total amount A<sub>2</sub> in one week, and no external radiation dose rate exceeding one rem per hour at one meter from the external surface of the package.

(b) Compliance with the permitted activity release limits of paragraph (a) of this section must not depend upon filters or upon a mechanical cooling system.

**§ 71.52 Exemption for low specific activity (LSA) packages.**

A package need not satisfy the requirements of § 71.51 if it contains only low specific activity material and is transported as exclusive use, but is subject to §§ 71.41-71.47 of this part, including § 71.43(f).

**§ 71.53 Fissile material exemptions.**

The following packages are exempt from fissile material classification and from the fissile material standards of §§ 71.55-71.61, but are subject to all other requirements of this part:

(a) A package containing not more than 15 grams of fissile radionuclides. If material is transported in bulk, the quantity limitation applies to the conveyance; or

(b) A package containing irradiated natural or depleted uranium including the products of irradiation if the irradiation has taken place only in a thermal reactor; or

(c) A package containing homogenous

hydrogenous solutions or mixtures where:

(1) The minimum ratio of the number of hydrogen atoms to the number of atoms of fissile radionuclides(H/X) is 8200;

(2) The maximum concentration of fissile radionuclides is five grams/liter; and

(3) The maximum mass of fissile radionuclides in the package is 600 grams, except for a mixture where the total mass of plutonium and uranium-233 exceeds one percent of the mass of uranium-235 the limit is 800 grams. If the material is transported in bulk, the quantity limitations apply to the vehicle, to a hold or compartment of an inland waterway craft, or to a hold, compartment, or defined deck area of a seagoing vessel; or

(d) A package containing uranium enriched in uranium-235 to a maximum of one percent by weight, and with a total plutonium and uranium-233 content of up to one percent of the mass of uranium-235, if the fissile radionuclides are distributed homogeneously throughout the package contents, and do not form a lattice arrangement within the package; or

(e) A package containing any fissile material if it does not contain more than five grams of fissile radionuclides in any 10-liter volume, and if the material is packaged so as to maintain this limit of fissile radionuclide concentration during normal transport; or

(f) A package containing not more than one kilogram of plutonium of which not more than 20% by mass may consist of plutonium-239, plutonium-241, or any combination of those radionuclides; or

(g) A package containing liquid solutions of uranyl nitrate enriched in uranium-235 to a maximum of two percent by weight, with total plutonium and uranium-233 not more than one-tenth percent of the mass of uranium-235.

**§ 71.55 General requirements for all fissile material packages.**

(a) A package used for the shipment of fissile material must be designed and constructed in accordance with §§ 71.41-71.47. When required by the total amount of radioactive material, a package used for the shipment of fissile material must also be designed and constructed in accordance with § 71.51.

(b) Except as provided in paragraph (c) of this section, a package used for the shipment of fissile material must be so designed and constructed and its contents so limited that it would be subcritical if water were to leak into the containment system or liquid contents were to leak out of the containment system so that, under the following conditions, maximum reactivity of the fissile material would be attained:

(1) The most reactive credible configuration consistent with the chemical and physical form of the material;

(2) Moderation by water to the most reactive credible extent; and

(3) Close reflection by water on all sides.

(c) The Commission may approve exceptions to the requirements of paragraph (b) of this section if the package incorporates special design features that ensure that no single packaging error would permit leakage, and if appropriate measures are taken before each shipment to ensure the containment system does not leak.

(d) A package used for the shipment of fissile material must be so designed and constructed and its contents so limited that under the tests specified in § 71.73 (Normal Conditions of Transport):

(1) The contents would be subcritical;

(2) The geometric form of the package contents would not be substantially altered;

(3) There would be no leakage of water into the containment system unless, in the evaluation of undamaged packages under §§ 71.57(a), 71.59(b)(1), and 71.61(a), it has been assumed that moderation is present to such an extent as to cause maximum reactivity consistent with the chemical and physical form of the material; and

(4) There will be no substantial reduction in the effectiveness of the packaging, including:

(i) No more than five percent reduction in the total effective volume of the packaging on which nuclear safety is assessed;

(ii) No more than five percent reduction in the effective spacing between the fissile contents and the outer surface of the packaging; and

(iii) No occurrence of an aperture in the outer surface of the packaging large enough to permit the entry of a 10 cm (four in.) cube.

(e) A package used for the shipment of fissile material must be so designed and constructed and its contents so limited that under the tests specified in § 71.73 (Hypothetical Accident Conditions), the package would be subcritical. For this determination, it must be assumed that:

(1) The fissile material is in the most reactive credible configuration consistent with the damaged condition of the package and the chemical and physical form of the contents;

(2) Water moderation occurs to the most reactive credible extent consistent with the damaged condition of the package and the chemical and physical form of the contents; and

(3) There is reflection by water on all sides, as close as is consistent with the damaged condition of the package.

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### § 71.57 Specific standards for a Fissile Class I package.

A Fissile Class I package must be so designed and constructed and its contents so limited that:

(a) Any number of undamaged packages would be subcritical in any arrangement and with optimum interspersed hydrogenous moderation unless there is a greater amount of interspersed moderation in the packaging, in which case the greater amount may be assumed for this determination; and

(b) Two hundred fifty (250) packages, if each package were subjected to the tests specified in § 71.73 (Hypothetical Accident Conditions), would be subcritical if stacked together in any arrangement, closely reflected on all sides of the stack by water, and with optimum interspersed hydrogenous moderation.

### § 71.59 Specific standards for a Fissile Class II package.

(a) A Fissile Class II package must be controlled by the carrier during transport. To provide this control, the designer of a Fissile Class II package must determine the allowable number of packages of that design which can be safely transported in a vehicle under the conditions specified in this section. This allowable number of packages determines the minimum transport index which the shipper of the package marks on the package label when the package is shipped. By limiting to 50 the total number of transport indexes in a vehicle or storage area, the carrier provides adequate criticality control.

(b) A Fissile Class II package must be designed and constructed and its contents so limited, and the allowable number of these packages in a Fissile Class II shipment so determined, that:

(1) Five times the allowable number of undamaged packages would be subcritical if stacked together in any arrangement and closely reflected on all sides of the stack by water; and

(2) Twice the allowable number of packages, if each package were subjected to the tests specified in § 71.73 (Hypothetical Accident Conditions), would be subcritical if stacked together in any arrangement, closely reflected on all sides of the stack by water, and with optimum interspersed hydrogenous moderation.

(c) The transport index with respect to criticality control for each Fissile Class II package must be calculated by dividing the number 50 by the allowable number of Fissile Class II packages which may be transported together as determined under the limitations of paragraph (b) of this section. The transport index so determined must not

exceed 10 and must be rounded up to the first decimal place.

### § 71.61 Specific standards for a Fissile Class III shipment.

A package for Fissile Class III shipment must be so designed and constructed and its contents so limited, and the number of packages in a Fissile Class III shipment must be so limited, that:

(a) Twice this number of undamaged packages would be subcritical if stacked together in any arrangement, assuming close reflection on all sides of the stack by water; and

(b) This number of packages would be subcritical if stacked together in any arrangement, closely reflected on all sides of the stack by water, and with optimum interspersed hydrogenous moderation. Except as permitted under § 71.41, each package must be considered to have been subjected to the tests specified in § 71.73 (Hypothetical Accident Conditions).

### § 71.63 Special requirements for plutonium shipments.

(a) Plutonium in excess of 20 curies per package must be shipped as a solid.

(b) Plutonium in excess of 20 curies per package must be packaged in a separate inner container placed within outer packaging that meets the requirements of Subparts E and F for packaging of material in normal form. If the entire package is subjected to the tests specified in § 71.71 (Normal Conditions of Transport), the separate inner container must not release plutonium, as demonstrated to a sensitivity of  $10^{-4}$  A<sub>s</sub> per hour. If the entire package is subjected to the tests specified in § 71.73 (Hypothetical Accident Conditions), the separate inner container must restrict the loss of plutonium to not more than A<sub>s</sub> in one week. Solid plutonium in the following forms is exempt from the requirements of this paragraph:

- (1) Reactor fuel elements;
- (2) Metal or metal alloy; and
- (3) Other plutonium bearing solids that the Commission determines should be exempt from the requirements of this section.

### § 71.65 Additional requirements.

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

### Subpart F—Package and Special Form Tests\*

#### § 71.71 Normal conditions of transport.

(a) *Evaluation.* Evaluation of each package design under normal conditions of transport must include a determination of the effect on that design of the conditions and tests specified in this section. Separate specimens may be used for the free drop test, the compression test, and the penetration test if each specimen is subjected to the water spray test before being subjected to any of the other tests.

(b) *Initial conditions.* With respect to the initial conditions for the tests in this section, the demonstration of compliance with the requirements of this Part must be based on the ambient temperature preceding and following the tests remaining constant at that value between  $-29^{\circ}\text{C}$  ( $-20^{\circ}\text{F}$ ) and  $+38^{\circ}\text{C}$  ( $100^{\circ}\text{F}$ ) which is most unfavorable for the feature under consideration. The initial internal pressure within the containment system must be considered to be the maximum normal operating pressure, unless a lower internal pressure consistent with the ambient temperature considered to precede and follow the tests is more unfavorable.

(c) *Conditions and tests.* (1) *Heat.* An ambient temperature of  $38^{\circ}\text{C}$  ( $100^{\circ}\text{F}$ ) in still air, and insolation according to the following table:

INSULATION DATA

Form and location of surface	Total insolation for a 12 hour period (g cal/cm <sup>2</sup> )
Flat surfaces transported horizontally	
—Glass	None
—Other surfaces	800
Flat surfaces not transported horizontally	200
Curved surfaces	400

(2) *Cold.* An ambient temperature of  $-40^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$ ) in still air and shade.

(3) *Reduced external pressure.* An external pressure of 24.5 kilopascal (3.5 psi) absolute.

(4) *Increased external pressure.* An external pressure of 140 kilopascal (20 psi) absolute.

(5) *Vibration.* Vibration normally incident to transport.

(6) *Water spray.* A water spray that simulates exposure to rainfall of approximately five cm (two in.) per hour for at least one hour.

(7) *Free drop.* Between 1½ and 2½ hours after the conclusion of the water spray test, a free drop through the distance specified below onto a flat, essentially unyielding, horizontal surface, striking the surface in a position for which maximum damage is expected. For Fissile Class II packages, this free drop must be preceded by a

\* The package standards related to the tests in this subpart are contained in Subpart E.



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designee and to the Regional Administrator of the appropriate Nuclear Regulatory Commission Regional Office listed in Appendix A of Part 73 of this chapter.

(2) A notification delivered by mail must be postmarked at least seven days before the beginning of the seven-day period during which departure of the shipment is estimated to occur.

(3) A notification delivered by messenger must reach the office of the governor or of the governor's designee at least four days before the beginning of the seven-day period during which departure of the shipment is estimated to occur.

(i) A list of the names and mailing addresses of the governors' designees receiving advance notification of transportation of nuclear waste was published in the Federal Register on June 30, 1983 (48 FR 30221).

(ii) The list will be published annually in the Federal Register on or about June 30 to reflect any changes in information.

(iii) A list of the names and mailing addresses of the governors' designees is available upon request from the Director, Office of Governmental and Public Affairs, U.S. Nuclear Regulatory Commission, Washington, DC 20555.

(4) The licensee shall retain a copy of the notification as a record for one year.

(d) *Information to be furnished in advance notification of shipment.* Each advance notification of shipment of nuclear waste must contain the following information:

(1) The name, address, and telephone number of the shipper, carrier, and receiver of the nuclear waste shipment;

(2) A description of the nuclear waste contained in the shipment, as required by the regulations of DOT in 49 CFR 172.202 and 172.203(d);

(3) The point of origin of the shipment and the seven-day period during which departure of the shipment is estimated to occur;

(4) The seven-day period during which arrival of the shipment at state boundaries is estimated to occur;

(5) The destination of the shipment, and the seven-day period during which arrival of the shipment is estimated to occur; and

(6) A point of contact with a telephone number for current shipment information.

(e) *Revision notice.* A licensee who finds that schedule information previously furnished to a governor or governor's designee in accordance with this section will not be met, shall telephone a responsible individual in the office of the governor of the state or of the governor's designee and inform that individual of the extent of the delay beyond the schedule originally reported. The licensee shall maintain a record of the name of the individual contacted for one year.

(f) *Cancellation notice.* (1) Each licensee who cancels a nuclear waste shipment for which advance notification has been sent, shall send a cancellation notice to the governor of each state or the governor's designee previously notified and to the Regional Administrator of the appropriate Nuclear Regulatory Commission Regional Office listed in Appendix A of Part 73 of this chapter.

(2) The licensee shall state in the notice that it is a cancellation and shall identify the advance notification which is being cancelled. The licensee shall retain a copy of the notice as a record for one year.

#### §71.99 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, (the Act) or Title II of the Energy Reorganization Act of 1974, as amended, or any regulation or order issued under the Acts. A court order may be obtained for the payment of a civil penalty imposed under 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, as amended, or any rule, regulation, or order issued under the Acts, or any term, condition, or limitation of any license issued under the Acts, 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 under the Acts may be guilty of a crime and, upon conviction, may be punished by fine or imprisonment or both, as provided by law.

#### Subpart H—Quality Assurance

##### § 71.101 Quality assurance requirements.

(a) *Purpose.* This subpart describes quality assurance requirements applying to design, purchase, fabrication, handling, shipping, storing, cleaning, assembly, inspection, testing, operation, maintenance, repair, and modification of components of packaging which are important to safety. As used in this subpart, "quality assurance" comprises all those planned and systematic actions necessary to provide adequate confidence that a system or component will perform satisfactorily in service. Quality assurance includes quality control, which comprises those quality

assurance actions related to control of the physical characteristics and quality of the material or component to predetermined requirements.

(b) *Establishment of program.* Each licensee shall establish, maintain, and execute a quality assurance program satisfying each of the applicable criteria of this subpart, and satisfying any specific provisions which are applicable to the licensee's activities including procurement of packaging. The licensee shall apply the applicable criteria in a graded approach, and to an extent that is consistent with their importance to safety.

(c) *Approval of program.* Prior to the use of any package for the shipment of licensed material subject to this subpart, each licensee shall obtain Commission approval of its quality assurance program. Each licensee shall file a description of its quality assurance program, including a discussion of which requirements of this subpart are applicable and how they will be satisfied, with the Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555.

(d) *Existing package designs.* The provisions of this paragraph deal with packages which have been approved for use in accordance with this part prior to January 1, 1979, and which have been designed in accordance with the provisions of this part in effect at the time of application for package approval. Those packages will be accepted as having been designed in accordance with a quality assurance program which satisfies the provisions of paragraph (b) of this section.

(e) *Existing packages.* The provisions of this paragraph deal with packages which have been approved for use in accordance with this part prior to January 1, 1979, have been at least partially fabricated prior to that date, and for which the fabrication is in accordance with the provisions of this part in effect at the time of application for approval of package design. These packages will be accepted as having been fabricated and assembled in accordance with a quality assurance program which satisfies the provisions of paragraph (b) of this section.

(f) *Previously approved programs.* A Commission-approved quality assurance program which satisfies the applicable criteria of Appendix B of Part 50 of this chapter and which is established, maintained, and executed with regard to transport packages will be accepted as satisfying the requirements of paragraph (b) of this section. Prior to first use, the licensee shall notify the Director, Office of Nuclear Material Safety and



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(6) The activity of the water must be determined at that time.

(7) The activities determined in paragraphs (c)(3) and (c)(6) of this section must not exceed 0.05  $\mu\text{Ci}$ .

#### § 71.77 Tests for special form radioactive material.

(a) *Impact test.* The specimen must fall onto a flat, horizontal, essentially unyielding surface from a height of not less than nine m (30 ft).

(b) *Percussion test.* The specimen must be placed on a sheet of lead which is supported by a smooth solid surface and struck by the flat face of a steel billet so as to produce an impact equivalent to that resulting from a free fall of 1.4 kg (three lb.) through one m (40 in.). The flat face of the billet must be 25 mm (one in.) in diameter with the edges rounded to a radius of three mm (0.12 in.)  $\pm$  0.3 mm (0.012 in.). The lead, of hardness number 3.5 to 4.5 on the Vickers scale and not more than 25 mm (one in.) thick, must cover an area greater than that covered by the specimen. A fresh surface of lead must be used for each impact. The billet must strike the specimen so as to cause maximum damage.

(c) *Bending test.* The test is applicable only to long, slender sources with both a minimum length of 10 cm (four in.) and a length to minimum width ratio not less than 10. The specimen must be rigidly clamped in a horizontal position so that one-half of its length protrudes from the face of the clamp. The orientation of the specimen must be such that the specimen will suffer maximum damage when its free end is struck by the flat face of a steel billet. The billet must strike the specimen so as to produce an impact equivalent to that resulting from a free vertical fall of 1.4 kg (three lb.) through one m (40 in.). The flat face of the billet must be 25 mm (one in.) in diameter with the edges rounded off to a radius of three mm (0.12 in.)  $\pm$  0.3 mm (0.012 in.).

(d) *Heat test.* The specimen must be heated to a temperature of not less than 800°C (1475°F) in an atmosphere which is essentially air, and held at that temperature for a period of 10 minutes and must then be allowed to cool.

#### Subpart G—Operating Controls and Procedures

##### § 71.81 Applicability of operating controls and procedures.

A licensee subject to this part, who under a general or specific license transports licensed material or delivers licensed material to a carrier for transport, shall comply with the requirements of this Subpart G, with the

quality assurance requirements of Subpart H of this part, and with the general provisions of Subpart A of this part.

##### § 71.83 Assumptions as to unknown properties.

When the isotopic abundance, mass, concentration, degree of irradiation, degree of moderation, or other pertinent property of fissile material in any package is not known, the licensee shall package the fissile material as if the unknown properties have credible values that will cause the maximum nuclear reactivity.

##### § 71.85 Preliminary determinations.

Prior to the first use of any packaging for the shipment of licensed material:

(a) The licensee shall ascertain that there are no cracks, pinholes, uncontrolled voids, or other defects which could significantly reduce the effectiveness of the packaging;

(b) Where the maximum normal operating pressure will exceed 34.3 kilopascal (5 psi) gauge, the licensee shall test the containment system at an internal pressure at least 50% higher than the maximum normal operating pressure to verify the capability of that system to maintain its structural integrity at that pressure.

(c) The licensee shall conspicuously and durably mark the packaging with its model number, gross weight, and a package identification number assigned by the Nuclear Regulatory Commission. Prior to applying the model number, the licensee shall determine that the packaging has been fabricated in accordance with the design approved by the Commission.

##### § 71.87 Routine determinations.

Prior to each shipment of licensed material, the licensee shall ensure that the package with its contents satisfies the applicable requirements of this part and of the license. The licensee shall determine that:

(a) The package is proper for the contents to be shipped;

(b) The package is in unimpaired physical condition except for superficial defects such as marks or dents;

(c) Each closure device of the packaging, including any required gasket, is properly installed and secured and free of defects;

(d) Any system for containing liquid is adequately sealed and has adequate space or other specified provision for expansion of the liquid;

(e) Any pressure relief device is operable and set in accordance with written procedures;

(f) The package has been loaded and closed in accordance with written procedures;

(g) For fissile material, any moderator or neutron absorber, if required, is present and in proper condition;

(h) Any structural part of the package which could be used to lift or tie down the package during transport is rendered inoperable for that purpose unless it satisfies the design requirements of § 71.45;

(i)(1) The level of non-fixed (removable) radioactive contamination on the external surfaces of each package offered for shipment is as low as reasonably achievable. The level of non-fixed radioactive contamination may be determined by wiping an area of 300 square centimeters of the surface concerned with an absorbent material, using moderate pressure, and measuring the activity on the wiping material. Sufficient measurements must be taken in the most appropriate locations to yield a representative assessment of the non-fixed contamination levels. Except as provided under paragraph (i)(2) of this section, the amount of radioactivity measured on any single wiping material when averaged over the surface wiped, must not exceed the limits given in Table V of this part at any time during transport. Other methods of assessment of equal or greater efficiency may be used. When other methods are used, the detection efficiency of the method used must be taken into account and in no case may the non-fixed contamination on the external surfaces of the package exceed ten times the limits listed in Table V.

TABLE V—REMOVABLE EXTERNAL RADIOACTIVE CONTAMINATION WIPE LIMITS

Contaminant	Maximum permissible limits	
	$\mu\text{Ci}/\text{cm}^2$	$\text{dpm}/\text{cm}^2$
Beta gamma emitting radionuclides, all radionuclides with half-lives less than ten years, natural uranium, natural thorium, uranium-235, uranium-238, thorium-232, thorium-230 and thorium-230 when contained in ores or physical concentrates	$10^{-5}$	22
All other alpha emitting radionuclides	$10^{-6}$	2.2

(2) In the case of packages transported as exclusive use shipments by rail or highway only, the non-fixed radioactive contamination at any time during transport must not exceed ten times the levels prescribed in paragraph (i)(1) of this section. The levels at the beginning of transport must not exceed the levels prescribed in paragraph (i)(1) of this section:

(j) External radiation levels around the package and around the vehicle, if applicable, will not exceed the limits specified in § 71.47 at any time during transportation; and

(k) Accessible package surface

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temperatures will not exceed the limits specified in § 71.43(g) at any time during transportation.

#### § 71.88 Air transport of plutonium.

(a) Notwithstanding the provisions of any general licenses and notwithstanding any exemptions stated directly in this part or included indirectly by citation of 49 CFR Chapter 1, as may be applicable, the licensee shall assure that plutonium in any form, whether for import, export, or domestic shipment, is not transported by air or delivered to a carrier for air transport unless:

- (1) The plutonium is contained in a medical device designed for individual human application; or
- (2) The plutonium is contained in a material in which the specific activity is not greater than 0.002 microcuries per gram of material and in which the radioactivity is essentially uniformly distributed; or
- (3) The plutonium is shipped in a single package containing no more than an  $A_2$  quantity of plutonium in any isotope or form and is shipped in accordance with § 71.5 of this part; or
- (4) The plutonium is shipped in a package specifically authorized for the shipment of plutonium by air in the Certificate of Compliance for that package issued by the Commission.

(b) Nothing in paragraph (a) of this section is to be interpreted as removing or diminishing the requirements of § 73.24 of this chapter.

(c) There have been two orders issued by the NRC restricting the air shipment of plutonium in accordance with Pub. L. 94-79. The first order, issued on August 15, 1975 was superseded by the second order dated September 1, 1978, which has remained in effect since that time. As of the effective date of this rule, the outstanding order dated September 1, 1978 is revoked.

#### § 71.89 Opening instructions.

Prior to delivery of a package to a carrier for transport, the licensee shall ensure that any special instructions needed to safely open the package have been sent to or otherwise made available to the consignee for the consignee's use in accordance with § 20.205 of this chapter.

#### § 71.91 Records.

(a) Each licensee shall maintain for a period of two years after shipment a record of each shipment of license

material not exempt under § 71.10, showing, where applicable:

- (1) Identification of the packaging by model number;
- (2) Verification that there are no significant defects in the packaging, as shipped;
- (3) Volume and identification of coolant;
- (4) Type and quantity of licensed material in each package, and the total quantity of each shipment;
- (5) For each item of irradiated fissile material:
  - (i) Identification by model number and/or serial number;
  - (ii) Irradiation and decay history to the extent appropriate to demonstrate that its nuclear and thermal characteristics comply with license conditions; and
  - (iii) Any abnormal or unusual condition relevant to radiation safety.
- (6) Date of the shipment;
- (7) For Fissile Class III and for Type B packages, any special controls exercised;
- (8) Name and address of the transferee;
- (9) Address to which the shipment was made; and
- (10) Results of the determinations required by § 71.87.

(b) The licensee shall make available to the Commission for inspection, upon reasonable notice, all records required by this part.

(c) The licensee shall maintain, during the life of the packaging to which they pertain, sufficient quality assurance records to furnish documentary evidence of the quality of packaging components which have safety significance and of services affecting quality. The records to be maintained include results of the determinations required by § 71.85, of monitoring, inspection, and auditing of work performance during the design, fabrication, assembly, testing, modification, maintenance, and repair of the packaging.

#### § 71.93 Inspection and tests.

- (a) The licensee shall permit the Commission at all reasonable times to inspect the licensed material, packaging, premises, and facilities in which the licensed material or packaging is used, produced, tested, stored, or shipped.
- (b) The licensee shall perform, and permit the Commission to perform, tests as the Commission deems necessary or appropriate for the administration of the regulations in this chapter.

(c) The licensee shall notify the Regional Administrator of the appropriate Nuclear Regulatory Commission Regional Office listed in Appendix A of Part 73 of this

chapter at least 45 days prior to fabrication of a package to be used for the shipment of licensed material having a decay heat load in excess of five kilowatts or with a maximum normal operating pressure in excess of 103 kilopascal (15psi) gauge.

#### § 71.95 Reports.

The licensee shall report to the Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555, within 30 days:

- (a) Any instance in which there is significant reduction in the effectiveness of any authorized packaging during use; and
- (b) Details of any defects with safety significance in the packaging after first use, with the means employed to repair the defects and prevent their recurrence.

#### § 71.97 Advance notification of shipment of nuclear waste.

(a) Except as specified in paragraph (b) of this section, prior to the transport or delivery to a carrier for transport of licensed material outside the confines of the licensee's plant or other place of use or storage, each licensee shall provide advance notification to the governor of a state, or the governor's designee, of the shipment to, through, or across the boundary of the state.

(b) Advance notification is required only when—

- (1) The licensed material is required by this part to be in Type B packaging for transportation;
- (2) The licensed material other than irradiated fuel is being transported to, through, or across state boundaries to a disposal site or to a collection point for transport to a disposal site;
- (3) The quantity of licensed material in a single package exceeds:
  - (i) 5,000 curies of special form radionuclides;
  - (ii) 5,000 curies of uncompressed gases of Argon-41, Krypton-85m, Krypton-87, Xenon-131m, or Xenon-135;
  - (iii) 50,000 curies of Argon-37, or of uncompressed gases of Krypton-85 or Xenon-133, or of Hydrogen-3 as a gas, as luminous paint, or adsorbed on solid material;
  - (iv) 20 curies of other non-special form radionuclides for which  $A_2$  is less than or equal to four curies; or
  - (v) 200 curies of other non-special form radionuclides for which  $A_2$  is greater than four curies; and
- (4) The quantity of irradiated fuel is less than that subject to advance notification requirements of 10 CFR Part 73.

(c) Procedures for submitting advance notification. (1) The notification must be made in writing to the office of each appropriate governor or governor's



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safeguards. U.S. Nuclear Regulatory Commission, Washington, DC 20555, of its intent to apply its previously approved Appendix B program to transportation activities. The licensee shall identify the program by date of submittal to the Commission, Docket Number, and date of Commission approval.

#### § 71.103 Quality assurance organization.

The licensee<sup>3</sup> shall be responsible for the establishment and execution of the quality assurance program. The licensee may delegate to others, such as contractors, agents, or consultants, the work of establishing and executing the quality assurance program, or any part of the quality assurance program, but shall retain responsibility for the program. The licensee shall clearly establish and delineate in writing the authority and duties of persons and organizations performing activities affecting the safety-related functions of structures, systems and components. These activities include performing the functions associated with attaining quality objectives and the quality assurance functions. The quality assurance functions are (a) assuring that an appropriate quality assurance program is established and effectively executed and (b) verifying, by procedures such as checking, auditing, and inspection, that activities affecting the safety-related functions have been correctly performed. The persons and organizations performing quality assurance functions must have sufficient authority and organizational freedom to identify quality problems; to initiate, recommend, or provide solutions; and to verify implementation of solutions. The persons and organizations performing quality assurance functions shall report to a management level which assures that the required authority and organizational freedom, including sufficient independence from cost and schedule when opposed to safety considerations, are provided. Because of the many variables involved, such as the number of personnel, the type of activity being performed, and the location or locations where activities are performed, the organizational structure for executing the quality assurance program may take various forms provided that the persons and organizations assigned the quality assurance functions have the required

<sup>3</sup> While the term "licensee" is used in these criteria, the requirements are applicable to whatever design, fabrication, assembly, and testing of the package is accomplished with respect to a package prior to the time a package approval is issued.

authority and organizational freedom. Irrespective of the organizational structure, the individual(s) assigned the responsibility for assuring effective execution of any portion of the quality assurance program at any location where activities subject to this section are being performed must have direct access to the levels of management necessary to perform this function.

#### § 71.105 Quality assurance program.

(a) The licensee shall establish, at the earliest practicable time consistent with the schedule for accomplishing the activities, a quality assurance program which complies with the requirements of this section. The licensee shall document the quality assurance program by written procedures or instructions and shall carry out the program in accordance with those procedures throughout the period during which packaging is used. The licensee shall identify the material and components to be covered by the quality assurance program, the major organizations participating in the program, and the designated functions of these organizations.

(b) The licensee, through its quality assurance program, shall provide control over activities affecting the quality of the identified materials and components to an extent consistent with their importance to safety, and as necessary to assure conformance to the approved design of each individual package used for the shipment of radioactive material. The licensee shall assure that activities affecting quality are accomplished under suitably controlled conditions. Controlled conditions include the use of appropriate equipment, suitable environmental conditions for accomplishing the activity, such as adequate cleanliness, and assurance that all prerequisites for the given activity have been satisfied. The licensee shall take into account the need for special controls, processes, test equipment, tools and skills to attain the required quality, and the need for verification of quality by inspection and test.

(c) The licensee shall base the requirements and procedures of its quality assurance program on the following considerations concerning the complexity and proposed use of the package and its components:

- (1) The impact of malfunction or failure of the item to safety;
- (2) The design and fabrication complexity or uniqueness of the item;
- (3) The need for special controls and surveillance over processes and equipment;

(4) The degree to which functional compliance can be demonstrated by inspection or test; and

(5) The quality history and degree of standardization of the item.

(d) The licensee shall provide for indoctrination and training of personnel performing activities affecting quality as necessary to assure that suitable proficiency is achieved and maintained. The licensee shall review the status and adequacy of the quality assurance program at established intervals. Management of other organizations participating in the quality assurance program shall regularly review the status and adequacy of that part of the quality assurance program which they are executing.

#### § 71.107 Package design control.

(a) The licensee shall establish measures to assure that applicable regulatory requirements and the package design, as specified in the license for those materials and components to which this section applies, are correctly translated into specifications, drawings, procedures, and instructions. These measures must include provisions to assure that appropriate quality standards are specified and included in design documents and that deviations from standards are controlled. Measures must be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the safety-related functions of the materials, parts, and components of the packaging.

(b) The licensee shall establish measures for the identification and control of design interfaces and for coordination among participating design organizations. These measures must include the establishment of written procedures among participating design organizations for the review, approval, release, distribution, and revision of documents involving design interfaces. The design control measures must provide for verifying or checking the adequacy of design, by methods such as design reviews, alternate or simplified calculational methods, or by a suitable testing program. For the verifying or checking process, the licensee shall designate individuals or groups other than those who were responsible for the original design, but who may be from the same organization. Where a test program is used to verify the adequacy of a specific design feature in lieu of other verifying or checking processes, the licensee shall include suitable qualification testing of a prototype or sample unit under the most adverse design conditions. The licensee shall



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performed upon individual items of the packaging. These measures must provide for the identification of items which have satisfactorily passed required inspections and tests where necessary to preclude inadvertent bypassing of the inspections and tests.

(b) The licensee shall establish measures to identify the operating status of components of the packaging, such as tagging valves and switches, to prevent inadvertent operation.

§ 71.131 Nonconforming materials, parts, or components.

The licensee shall establish measures to control materials, parts, or components which do not conform to the licensee's requirements in order to prevent their inadvertent use or installation. These measures must include, as appropriate, procedures for identification, documentation, segregation, disposition, and notification to affected organizations. Nonconforming items must be reviewed and accepted, rejected, repaired, or reworked in accordance with documented procedures.

§ 71.133 Corrective action.

The licensee shall establish measures to assure that conditions adverse to quality, such as deficiencies, deviations, defective material and equipment, and nonconformances, are promptly identified and corrected. In the case of a significant condition adverse to quality, the measures must assure that the cause of the condition is determined and corrective action taken to preclude repetition. The identification of the significant condition adverse to quality, the cause of the condition, and the corrective action taken must be documented and reported to appropriate levels of management.

§ 71.135 Quality assurance records.

(a) The licensee shall maintain sufficient written records to furnish evidence of activities affecting quality. The records must include the following: design records, records of use and the results of reviews, inspections, tests, audits, monitoring of work performance, and materials analyses. The records must include closely related data such as qualifications of personnel, procedures, and equipment. Inspection and test records must, at a minimum, identify the inspector or data recorder, the type of observation, the results, the acceptability, and the action taken in connection with any deficiencies noted. Records must be identifiable and retrievable. Records pertaining to the fabrication of the package must be

retained for the life of the package to which they apply. Records pertaining to the use of the package for shipment of radioactive material must be retained for a period of two years after the shipment.

(b) The licensee shall establish a records retention program which is consistent with the applicable regulations, designating factors such as duration, location, and assigned responsibility.

§ 71.137 Audits.

The licensee shall carry out a comprehensive system of planned and periodic audits to verify compliance with all aspects of the quality assurance program and to determine the effectiveness of the program. The audits must be performed in accordance with written procedures or checklists by appropriately trained personnel not having direct responsibilities in the areas being audited. Audited results must be documented and reviewed by management having responsibility in the area audited. Follow-up action, including re-audit of deficient areas, must be taken where indicated.

Appendix A—Determination of  $A_1$  and  $A_2$

1. Single radionuclides.

(1) For a single radionuclide of known identity, the values of  $A_1$  and  $A_2$  are taken from Table A-1 if listed there. The values  $A_1$  and  $A_2$  in Table A-1 are also applicable for radionuclides contained in (a, n) or (y, b) neutron sources.

(2) For any single radionuclide whose identity is known but which is not listed in Table A-1, the values of  $A_1$  and  $A_2$  are determined according to the following procedure:

(a) If the radionuclide emits only one type of radiation,  $A_1$  is determined according to the rules in paragraphs (i), (ii), (iii) and (iv) of this paragraph. For radionuclides emitting different kinds of radiation,  $A_1$  is the most restrictive value of those determined for each kind of radiation. However, in both cases,  $A_1$  is restricted to a maximum of 1000 Ci. If a parent nuclide decays into a shorter lived daughter with a half-life not greater than 10 days,  $A_1$  is calculated for both the parent and the daughter, and the more limiting of the two values is assigned to the parent nuclide.

(i) For gamma emitters,  $A_1$  is determined by the expression:

$$A_1 = \frac{Q}{\Gamma} \text{ curies}$$

where  $\Gamma$  is the gamma-ray constant, corresponding to the dose in R/h at 1 m per Ci; the number 6 results from the choice of 1 rem/h at a distance of 3 m as the reference dose-equivalent rate.

(ii) For X-ray emitters,  $A_1$  is determined by the atomic number of the nuclide:

$$\text{for } Z < 55 - A_1 = 1000 \text{ Ci}$$

$$\text{for } Z > 55 - A_1 = 250 \text{ Ci}$$

where  $Z$  is the atomic number of the nuclide.

(iii) For beta emitters,  $A_1$  is determined by the maximum beta energy ( $E_{\text{max}}$ ) according to Table A-2.

(iv) For alpha emitters,  $A_1$  is determined by the expression:

$$A_1 = 1000 A_2$$

where  $A_2$  is the value listed in Table A-3;

(b)  $A_2$  is the more restrictive of the following two values:

(i) The corresponding  $A_1$ ; and

(ii) The value  $A_2$  obtained from Table A-3.

(3) For any single radionuclide whose identity is unknown, the value of  $A_1$  is taken to be 20 Ci and the value of  $A_2$  is taken to be 0.002 Ci. However, if the atomic number of the radionuclide is known to be less than 82, the value of  $A_1$  is taken to be 10 Ci and the value of  $A_2$  is taken to be 0.4 Ci.

B. Mixtures of radionuclides, including radioactive decay chains.

(1) For mixed fission products the following activity limits may be assumed if a detailed analysis of the mixture is not carried out:

$$A_1 = 10 \text{ Ci}$$

$$A_2 = 0.4 \text{ Ci}$$

(2) A single radioactive decay chain is considered to be a single radionuclide when the radionuclides are present in their naturally occurring proportions and no daughter nuclide has a half-life either longer than 10 days or longer than that of the parent nuclide. The activity to be taken into account and the  $A_1$  or  $A_2$  value from Table A-1 to be applied are those corresponding to the parent nuclide of that chain. When calculating  $A_1$  or  $A_2$  values, radiation emitted by daughters must be considered. However, in the case of radioactive decay chains in which any daughter nuclide has a half-life either longer than 10 days or greater than that of the parent nuclide, the parent and daughter nuclides are considered to be mixtures of different nuclides.

(3) In the case of a mixture of different radionuclides, where the identity and activity of each radionuclide are known, the permissible activity of each radionuclide  $R_1, R_2, \dots, R_n$  is such that  $F_1 + F_2 + \dots + F_n$  is not greater than unity, where

$$F_1 = \frac{\text{Total activity of } R_1}{A_1(R_1)}$$

$$F_2 = \frac{\text{Total activity of } R_2}{A_2(R_2)}$$

$$F_n = \frac{\text{Total activity of } R_n}{A_n(R_n)}$$

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apply design control measures to items such as the following: criticality physics, radiation shielding, stress, thermal, hydraulic, and accident analyses; compatibility of materials; accessibility for inservice inspection, maintenance, and repair; features to facilitate decontamination; and delineation of acceptance criteria for inspections tests.

(c) The licensee shall subject design changes, including field changes, to design control measures commensurate with those applied to the original design. Changes in the conditions specified in the package approval require NRC approval.

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§ 71.109 Procurement document control.

The licensee shall establish measures to assure adequate quality is required in the documents for procurement of material, equipment, and services, whether purchased by the licensee or by its contractors or subcontractors. To the extent necessary, the licensee shall require contractors or subcontractors to provide a quality assurance program consistent with the applicable provisions of this part.

§ 71.111 Instructions, procedures, and drawings.

The licensee shall prescribe activities affecting quality by documented instructions, procedures, or drawings of a type appropriate to the circumstances and shall require that these instructions, procedures, and drawings be followed. The instructions, procedures, and drawings must include appropriate quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished.

§ 71.113 Document control.

The licensee shall establish measures to control the issuance of documents such as instructions, procedures, and drawings, including changes, which prescribe all activities affecting quality. These measures must assure that documents, including changes, are reviewed for adequacy, approved for release by authorized personnel, and distributed and used at the location where the prescribed activity is performed. These measures must assure that changes to documents are reviewed and approved.

§ 71.115 Control of purchased material, equipment, and services.

(a) The licensee shall establish measures to assure that purchased material, equipment, and services, whether purchased directly or through contractors and subcontractors, conform to the procurement documents. These

measures must include provisions, as appropriate, for source evaluation and selection, objective evidence of quality furnished by the contractor or subcontractor, inspection at the contractor or subcontractor source, and examination of products upon delivery.

(b) The licensee shall have available documentary evidence that material and equipment conform to the procurement specifications prior to installation or use of the material and equipment. The licensee shall retain or have available this documentary evidence for the life of the package to which it applies. The licensee shall assure that the evidence is sufficient to identify the specific requirements met by the purchased material and equipment.

(c) The licensee or designee shall assess the effectiveness of the control of quality by contractors and subcontractors at intervals consistent with the importance, complexity, and quantity of the product or services.

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§ 71.117 Identification and control of materials, parts, and components.

The licensee shall establish measures for the identification and control of materials, parts, and components. These measures must assure that identification of the item is maintained by heat number, part number, or other appropriate means, either on the item or on records traceable to the item, as required throughout fabrication, installation, and use of the item. These identification and control measures must be designed to prevent the use of incorrect or defective materials, parts, and components.

§ 71.119 Control of special processes.

The licensee shall establish measures to assure that special processes, including welding, heat treating, and nondestructive testing, are controlled and accomplished by qualified personnel using qualified procedures in accordance with applicable codes, standards, specifications, criteria, and other special requirements.

§ 71.121 Internal inspection.

The licensee shall establish and execute a program for inspection of activities affecting quality by or for the organization performing the activity to verify conformance with the documented instructions, procedures, and drawings for accomplishing the activity. The inspection must be performed by individuals other than those who performed the activity being inspected. Examination, measurements, or tests of material or products processed must be performed for each work operation where necessary to

assure quality. If direct inspection of processed material or products is not carried out, indirect control by monitoring processing methods, equipment, and personnel must be provided. Both inspection and process monitoring must be provided when quality control is inadequate without both. If mandatory inspection hold points, which require witnessing or inspecting by the licensee's designated representative and beyond which work should not proceed without the consent of its designated representative, are required, the specific hold points must be indicated in appropriate documents.

§ 71.123 Test control.

The licensee shall establish a test program to assure that all testing required to demonstrate that the packaging components will perform satisfactorily in service is identified and performed in accordance with written test procedures which incorporate the requirements of this part and the requirements and acceptance limits contained in the package approval. The test procedures must include provisions for assuring that all prerequisites for the given test are met, that adequate test instrumentation is available and used, and that the test is performed under suitable environmental conditions. The licensee shall document and evaluate the test results to assure that test requirements have been satisfied.

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§ 71.125 Control of measuring and test equipment.

The licensee shall establish measures to assure that tools, gages, instruments, and other measuring and testing devices used in activities affecting quality are properly controlled, calibrated, and adjusted at specified times to maintain accuracy within necessary limits.

§ 71.127 Handling, storage, and shipping control.

The licensee shall establish measures to control, in accordance with instructions, the handling, storage, shipping, cleaning, and preservation of materials and equipment to be used in packaging to prevent damage or deterioration. When necessary for particular products, special protective environments, such as inert gas atmosphere, and specific moisture content and temperature levels must be specified and provided.

§ 71.129 Inspection, test, and operating status.

(a) The licensee shall establish measures to indicate, by the use of markings such as stamps, tags, labels, routing cards, or other suitable means, the status of inspections and tests







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TABLE A-1.—A<sub>1</sub> AND A<sub>2</sub> VALUES FOR RADIONUCLIDES—Continued

(See footnotes at end of table)

Symbol of radionuclide	Element and atomic number	A <sub>1</sub> (Ci)	A <sub>2</sub> (Ci)	Specific activity (Ci/g)
82 <sub>Ba</sub>		6	6	1.1 × 10 <sup>4</sup>
11 <sub>C</sub>	Carbon (6)	20	20	8.4 × 10 <sup>4</sup>
14 <sub>C</sub>		1000	60	4.6
45 <sub>Ca</sub>	Calcium (20)	1000	25	1.9 × 10 <sup>4</sup>
47 <sub>Ca</sub>		20	20	5.9 × 10 <sup>4</sup>
109 <sub>Cd</sub>	Cadmium (48)	1000	70	2.6 × 10 <sup>3</sup>
115 <sub>mCd</sub>		30	30	2.6 × 10 <sup>4</sup>
115 <sub>Cd</sub>		60	20	5.1 × 10 <sup>4</sup>
139 <sub>Ce</sub>	Cerium (58)	100	100	6.5 × 10 <sup>3</sup>
141 <sub>Ce</sub>		300	25	2.6 × 10 <sup>4</sup>
143 <sub>Ce</sub>		60	20	6.6 × 10 <sup>4</sup>
144 <sub>Ce</sub>		10	7	3.2 × 10 <sup>3</sup>
248 <sub>Cf</sub>	Californium (98)	2	0.002	3.1
250 <sub>Cf</sub>		7	0.007	1.3 × 10 <sup>3</sup>
252 <sub>Cf</sub>		2	0.009	6.5 × 10 <sup>3</sup>
36 <sub>Cl</sub>	Chlorine (17)	300	10	3.2 × 10 <sup>-1</sup>
38 <sub>Cl</sub>		10	10	1.3 × 10 <sup>4</sup>
242 <sub>Cm</sub>	Curium (96)	200	0.2	3.3 × 10 <sup>3</sup>
243 <sub>Cm</sub>		9	0.009	4.2 × 10
244 <sub>Cm</sub>		10	0.01	6.2 × 10
245 <sub>Cm</sub>		6	0.006	1.0 × 10 <sup>-1</sup>
246 <sub>Cm</sub>		6	0.006	3.6 × 10 <sup>-1</sup>
56 <sub>Co</sub>	Cobalt (27)	5	5	3.0 × 10 <sup>4</sup>
57 <sub>Co</sub>		90	90	6.5 × 10 <sup>3</sup>
58 <sub>mCo</sub>		1000	1000	5.9 × 10 <sup>4</sup>
58 <sub>Co</sub>		20	20	3.1 × 10 <sup>4</sup>
60 <sub>Co</sub>		7	7	1.1 × 10 <sup>4</sup>
51 <sub>Cr</sub>	Chromium (24)	600	600	9.2 × 10 <sup>4</sup>
139 <sub>Cs</sub>	Cesium (55)	40	40	7.6 × 10 <sup>4</sup>
131 <sub>I</sub>		1000	1000	1.0 × 10 <sup>4</sup>
134 <sub>mCs</sub>		1000	10	7.4 × 10 <sup>4</sup>
134 <sub>Cs</sub>		10	10	1.2 × 10 <sup>3</sup>
135 <sub>Cs</sub>		1000	25	8.8 × 10 <sup>-1</sup>
136 <sub>Cs</sub>		7	7	7.4 × 10 <sup>4</sup>
137 <sub>Cs</sub>		30	10	9.8 × 10
64 <sub>Cu</sub>	Copper (29)	80	25	3.8 × 10 <sup>4</sup>
67 <sub>Cu</sub>		200	25	7.9 × 10 <sup>4</sup>
165 <sub>Dy</sub>	Dysprosium (66)	100	20	8.2 × 10 <sup>4</sup>
166 <sub>Dy</sub>		1000	200	2.3 × 10 <sup>4</sup>
169 <sub>Er</sub>	Erbium (68)	1000	25	8.2 × 10 <sup>4</sup>
171 <sub>Er</sub>		50	20	2.4 × 10 <sup>4</sup>
152 <sub>mEu</sub>	Europium (63)	30	30	2.2 × 10 <sup>4</sup>
152 <sub>Eu</sub>		20	10	1.9 × 10 <sup>4</sup>
154 <sub>Eu</sub>		10	5	1.5 × 10 <sup>3</sup>
155 <sub>Eu</sub>		400	60	1.4 × 10 <sup>3</sup>
18 <sub>F</sub>	Fluorine (9)	20	20	9.3 × 10 <sup>1</sup>
52 <sub>Fe</sub>	Iron (26)	5	5	7.3 × 10 <sup>4</sup>
55 <sub>Fe</sub>		1000	1000	2.2 × 10 <sup>3</sup>
59 <sub>Fe</sub>		10	10	4.9 × 10 <sup>4</sup>
67 <sub>Ga</sub>	Gallium (31)	100	100	6.0 × 10 <sup>4</sup>
68 <sub>Ga</sub>		20	20	4.0 × 10 <sup>7</sup>
72 <sub>Ga</sub>		7	7	3.1 × 10 <sup>4</sup>
153 <sub>Gd</sub>	Gadolinium (64)	200	100	3.6 × 10 <sup>3</sup>
159 <sub>Gd</sub>		300	20	1.1 × 10 <sup>4</sup>
68 <sub>Ge</sub>	Germanium (32)	20	10	7.0 × 10 <sup>3</sup>
71 <sub>Ge</sub>		1000	1000	1.6 × 10 <sup>4</sup>
3 <sub>H</sub>	Hydrogen (1) see T-Tritium			
181 <sub>Hf</sub>	Hafnium (72)	30	25	1.6 × 10 <sup>4</sup>
197 <sub>mHg</sub>	Mercury (80)	200	200	6.6 × 10 <sup>4</sup>
197 <sub>Hg</sub>		200	200	2.5 × 10 <sup>4</sup>
203 <sub>Hg</sub>		80	25	1.4 × 10 <sup>4</sup>
166 <sub>Ho</sub>	Holmium (67)	30	30	6.9 × 10 <sup>4</sup>
123 <sub>I</sub>	Iodine (53)	50	50	1.9 × 10 <sup>4</sup>
125 <sub>I</sub>		1000	70	1.7 × 10 <sup>4</sup>
126 <sub>I</sub>		40	10	7.8 × 10 <sup>4</sup>
129 <sub>I</sub>		1000	2	1.6 × 10 <sup>-1</sup>
131 <sub>I</sub>		40	10	1.2 × 10 <sup>4</sup>
132 <sub>I</sub>		7	7	1.1 × 10 <sup>1</sup>

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TABLE A-1.—A<sub>1</sub> AND A<sub>2</sub> VALUES FOR RADIONUCLIDES—Continued

(See footnotes at end of table)

Symbol of radionuclide	Element and atomic number	A <sub>1</sub> (Ci)	A <sub>2</sub> (Ci)	Specific activity (Ci/g)
133 <sub>I</sub>		30	10	1.1 × 10 <sup>6</sup>
134 <sub>I</sub>		8	8	2.7 × 10 <sup>7</sup>
135 <sub>I</sub>		10	10	3.5 × 10 <sup>6</sup>
111 <sub>In</sub>	Indium (49)	30	25	4.2 × 10 <sup>6</sup>
113 <sub>m</sub> <sub>In</sub>		80	80	1.6 × 10 <sup>7</sup>
114 <sub>m</sub> <sub>In</sub>		30	20	2.3 × 10 <sup>6</sup>
115 <sub>m</sub> <sub>In</sub>		100	20	6.1 × 10 <sup>6</sup>
190 <sub>In</sub>	Indium (77)	10	10	6.2 × 10 <sup>6</sup>
192 <sub>In</sub>		20	10	9.1 × 10 <sup>6</sup>
194 <sub>In</sub>		10	10	8.5 × 10 <sup>6</sup>
42 <sub>K</sub>	Potassium (19)	10	10	6.0 × 10 <sup>6</sup>
43 <sub>K</sub>		20	10	3.3 × 10 <sup>6</sup>
85 <sub>m</sub> <sub>Kr</sub> (uncompressed)*	Krypton (36)	100	100	6.4 × 10 <sup>6</sup>
85 <sub>m</sub> <sub>Kr</sub> (compressed)*		3	3	8.4 × 10 <sup>6</sup>
85 <sub>Kr</sub> (uncompressed)*		1000	1000	4.0 × 10 <sup>6</sup>
85 <sub>Kr</sub> (compressed)*		5	5	4.0 × 10 <sup>6</sup>
87 <sub>Kr</sub> (uncompressed)*		20	20	2.8 × 10 <sup>7</sup>
87 <sub>Kr</sub> (compressed)*		0.6	0.6	2.8 × 10 <sup>7</sup>
140 <sub>La</sub>	Lanthanum (57)	30	30	5.6 × 10 <sup>6</sup>
177 <sub>La</sub>	Low specific activity material—see § 71.4			
177 <sub>Lu</sub>	Lutetium (71)	300	25	1.1 × 10 <sup>6</sup>
237 <sub>Np</sub>	Mixed fission products	10	0.4	
28 <sub>Mg</sub>	Magnesium (12)	8	8	5.2 × 10 <sup>6</sup>
52 <sub>Mn</sub>	Manganese (25)	5	5	4.4 × 10 <sup>6</sup>
54 <sub>Mn</sub>		20	20	8.3 × 10 <sup>6</sup>
56 <sub>Mn</sub>		5	5	2.2 × 10 <sup>7</sup>
99 <sub>Mo</sub>	Molybdenum (42)	100	20	4.7 × 10 <sup>6</sup>
13 <sub>N</sub>	Nitrogen (7)	20	10	1.5 × 10 <sup>6</sup>
22 <sub>Na</sub>	Sodium (11)	8	8	6.3 × 10 <sup>6</sup>
24 <sub>Na</sub>		5	5	8.7 × 10 <sup>6</sup>
93 <sub>Nb</sub>	Niobium (41)	1000	200	1.1 × 10 <sup>6</sup>
95 <sub>Nb</sub>		20	20	3.9 × 10 <sup>6</sup>
97 <sub>Nb</sub>		20	20	2.6 × 10 <sup>7</sup>
147 <sub>Nd</sub>	Neodymium (60)	100	20	8.0 × 10 <sup>6</sup>
149 <sub>Nd</sub>		30	20	1.1 × 10 <sup>7</sup>
59 <sub>Ni</sub>	Nickel (28)	1000	900	8.1 × 10 <sup>-1</sup>
63 <sub>Ni</sub>		1000	100	4.6 × 10 <sup>6</sup>
65 <sub>Ni</sub>		10	10	1.9 × 10 <sup>7</sup>
237 <sub>Np</sub>	Neptunium (93)	5	0.005	6.9 × 10 <sup>-4</sup>
239 <sub>Np</sub>		200	25	2.3 × 10 <sup>6</sup>
185 <sub>Os</sub>	Osmium (76)	20	20	7.3 × 10 <sup>6</sup>
191 <sub>Os</sub>		600	200	4.6 × 10 <sup>6</sup>
191 <sub>m</sub> <sub>Os</sub>		200	200	1.2 × 10 <sup>6</sup>
193 <sub>Os</sub>		100	20	5.3 × 10 <sup>6</sup>
32 <sub>P</sub>	Phosphorus (15)	30	30	2.9 × 10 <sup>6</sup>
230 <sub>Pa</sub>	Protactinium (91)	20	0.8	3.2 × 10 <sup>6</sup>
231 <sub>Pa</sub>		2	0.002	4.5 × 10 <sup>-7</sup>
233 <sub>Pa</sub>		100	100	2.1 × 10 <sup>6</sup>
201 <sub>Pb</sub>	Lead (82)	20	20	1.7 × 10 <sup>6</sup>
210 <sub>Pb</sub>		100	0.2	8.8 × 10 <sup>6</sup>
212 <sub>Pb</sub>		8	5	1.4 × 10 <sup>6</sup>
103 <sub>Pd</sub>	Palladium (46)	1000	700	7.5 × 10 <sup>6</sup>
109 <sub>Pd</sub>		100	20	2.1 × 10 <sup>6</sup>
147 <sub>Pm</sub>	Promethium (61)	1000	25	9.4 × 10 <sup>6</sup>
149 <sub>Pm</sub>		100	20	4.2 × 10 <sup>6</sup>
210 <sub>Pm</sub>	Polonium (84)	200	0.2	4.5 × 10 <sup>6</sup>
142 <sub>Pr</sub>	Praseodymium (59)	10	10	1.2 × 10 <sup>6</sup>
143 <sub>Pr</sub>		300	20	6.6 × 10 <sup>6</sup>
191 <sub>Pt</sub>	Platinum (78)	100	100	2.3 × 10 <sup>6</sup>
193 <sub>m</sub> <sub>Pt</sub>		200	200	2.0 × 10 <sup>6</sup>
197 <sub>m</sub> <sub>Pt</sub>		300	20	1.2 × 10 <sup>6</sup>
197 <sub>Pt</sub>		300	20	8.8 × 10 <sup>6</sup>
238 <sub>Pu</sub>	Plutonium (94)	3	0.003	1.7 × 10 <sup>10</sup>
239 <sub>Pu</sub>		2	0.002	6.2 × 10 <sup>-7</sup>
240 <sub>Pu</sub>		2	0.002	2.3 × 10 <sup>-7</sup>
241 <sub>Pu</sub>		1000	0.1	1.1 × 10 <sup>6</sup>
242 <sub>Pu</sub>		3	0.003	3.9 × 10 <sup>7</sup>
223 <sub>Ra</sub>	Radium (88)	50	0.2	5.0 × 10 <sup>6</sup>

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TABLE A-1.—A<sub>1</sub> AND A<sub>2</sub> VALUES FOR RADIONUCLIDES—Continued

(See footnotes at end of table)

Symbol of radionuclide	Element and atomic number	A <sub>1</sub> (Ci)	A <sub>2</sub> (Ci)	Specific activity (Ci/g)
224 <sub>Ra</sub>		6	0.5	1.8 × 10 <sup>4</sup>
226 <sub>Ra</sub>		10	0.05	1.0
228 <sub>Ra</sub>		10	0.05	2.3 × 10 <sup>4</sup>
81 <sub>Rb</sub>	Rubidium (37)	30	25	8.2 × 10 <sup>4</sup>
86 <sub>Rb</sub>		30	30	8.1 × 10 <sup>4</sup>
87 <sub>Rb</sub>		Unlimited.	Unlimited.	6.6 × 10 <sup>-3</sup>
<sub>Ra</sub> (natural)		Unlimited.	Unlimited.	1.8 × 10 <sup>-3</sup>
186 <sub>Rh</sub>	Rhodium (45)	100	20	1.9 × 10 <sup>4</sup>
187 <sub>Rh</sub>		Unlimited.	Unlimited.	3.9 × 10 <sup>-3</sup>
188 <sub>Rh</sub>		10	10	1.0 × 10 <sup>4</sup>
<sub>Rh</sub> (natural)		Unlimited.	Unlimited.	2.4 × 10 <sup>-3</sup>
103m <sub>Rh</sub>	Rhodium (45)	1000	1000	3.2 × 10 <sup>4</sup>
105 <sub>Rh</sub>		200	25	8.2 × 10 <sup>4</sup>
222 <sub>Rn</sub>	Radon (86)	10	2	1.5 × 10 <sup>4</sup>
87 <sub>Ru</sub>	Ruthenium (44)	80	80	5.5 × 10 <sup>4</sup>
103 <sub>Ru</sub>		30	25	3.2 × 10 <sup>4</sup>
105 <sub>Ru</sub>		20	20	6.6 × 10 <sup>4</sup>
106 <sub>Ru</sub>		10	7	3.4 × 10 <sup>4</sup>
35 <sub>S</sub>	Sulphur (16)	1000	80	4.3 × 10 <sup>4</sup>
122 <sub>Sb</sub>	Antimony (51)	30	30	3.9 × 10 <sup>4</sup>
124 <sub>Sb</sub>		5	5	1.8 × 10 <sup>4</sup>
125 <sub>Sb</sub>		40	25	1.3 × 10 <sup>4</sup>
46 <sub>Sc</sub>	Scandium (21)	8	8	3.4 × 10 <sup>4</sup>
47 <sub>Sc</sub>		200	20	8.2 × 10 <sup>4</sup>
48 <sub>Sc</sub>		5	5	1.5 × 10 <sup>4</sup>
75 <sub>Se</sub>	Selenium (34)	40	40	1.4 × 10 <sup>4</sup>
31 <sub>Si</sub>	Silicon (14)	100	20	3.9 × 10 <sup>4</sup>
147 <sub>Sm</sub>	Samarium (62)	Unlimited.	Unlimited.	2.0 × 10 <sup>-8</sup>
151 <sub>Sm</sub>		1000	80	2.6 × 10 <sup>4</sup>
153 <sub>Sm</sub>		300	20	4.4 × 10 <sup>4</sup>
113 <sub>Sn</sub>	Tin (50)	80	80	1.0 × 10 <sup>4</sup>
119m <sub>Sn</sub>		100	100	4.4 × 10 <sup>4</sup>
125 <sub>Sn</sub>		10	10	1.1 × 10 <sup>4</sup>
85m <sub>Sr</sub>	Strontium (38)	80	80	3.2 × 10 <sup>4</sup>
85 <sub>Sr</sub>		30	30	2.4 × 10 <sup>4</sup>
87m <sub>Sr</sub>		50	50	1.2 × 10 <sup>4</sup>
89 <sub>Sr</sub>		100	10	2.9 × 10 <sup>4</sup>
90 <sub>Sr</sub>		10	0.4	1.5 × 10 <sup>4</sup>
91 <sub>Sr</sub>		10	10	3.6 × 10 <sup>4</sup>
92 <sub>Sr</sub>		10	10	1.3 × 10 <sup>4</sup>
† (uncompressed)*	Tritium (1)	1000	1000	9.7 × 10 <sup>3</sup>
† (compressed)*		1000	1000	9.7 × 10 <sup>3</sup>
† (activated luminous paint)		1000	1000	9.7 × 10 <sup>3</sup>
† (adsorbed on solid carrier)		1000	1000	9.7 × 10 <sup>3</sup>
† (trifluated water)		1000	1000	9.7 × 10 <sup>3</sup>
† (other forms)		20	20	9.7 × 10 <sup>3</sup>
182 <sub>Ta</sub>	Tantalum (73)	20	20	6.2 × 10 <sup>4</sup>
180 <sub>Tm</sub>	Terbium (65)	20	10	1.1 × 10 <sup>4</sup>
96m <sub>Tc</sub>	Technetium (43)	1000	1000	3.8 × 10 <sup>4</sup>
96 <sub>Tc</sub>		6	6	3.2 × 10 <sup>4</sup>
97m <sub>Tc</sub>		1000	200	1.5 × 10 <sup>4</sup>
97 <sub>Tc</sub>		1000	400	1.4 × 10 <sup>-3</sup>
99m <sub>Tc</sub>		100	100	5.2 × 10 <sup>4</sup>
99 <sub>Tc</sub>		1000	25	1.7 × 10 <sup>-8</sup>
125m <sub>Tc</sub>	Tellurium (52)	1000	100	1.8 × 10 <sup>4</sup>
127m <sub>Tc</sub>		300	20	4.0 × 10 <sup>4</sup>
127 <sub>Tc</sub>		300	20	2.6 × 10 <sup>4</sup>
129m <sub>Tc</sub>		30	10	2.5 × 10 <sup>4</sup>
129 <sub>Tc</sub>		100	20	2.0 × 10 <sup>4</sup>
131m <sub>Tc</sub>		10	10	8.0 × 10 <sup>4</sup>
132 <sub>Tc</sub>		7	7	3.1 × 10 <sup>4</sup>
227 <sub>Th</sub>	Thorium (90)	200	0.2	3.2 × 10 <sup>4</sup>
228 <sub>Th</sub>		6	0.008	8.3 × 10 <sup>3</sup>
230 <sub>Th</sub>		3	0.003	1.9 × 10 <sup>-8</sup>
231 <sub>Th</sub>		1000	25	5.3 × 10 <sup>4</sup>
232 <sub>Th</sub>		Unlimited.	Unlimited.	1.1 × 10 <sup>-1</sup>
234 <sub>Th</sub>		10	10	2.3 × 10 <sup>4</sup>
<sub>Th</sub> (natural)		Unlimited.	Unlimited.	2.2 × 10 <sup>-1</sup>

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TABLE A-1.— $A_1$  AND  $A_2$  VALUES FOR RADIONUCLIDES—Continued

(See footnotes at end of table)

Symbol of radionuclide	Element and atomic number	$A_1$ (Ci)	$A_2$ (Ci)	Specific activity (Ci/g)
$^{200}\text{Tl}$ (irradiated)**	Thallium (81)	20	20	$5.8 \times 10^2$
$^{201}\text{Tl}$		200	200	$2.2 \times 10^2$
$^{202}\text{Tl}$		40	40	$5.4 \times 10^2$
$^{204}\text{Tl}$		300	10	$4.3 \times 10^2$
$^{170}\text{Tm}$	Thulium (69)	300	10	$6.0 \times 10^2$
$^{171}\text{Tm}$		1000	100	$1.1 \times 10^2$
$^{230}\text{U}$	Uranium (82)	100	0.1	$2.7 \times 10^2$
$^{232}\text{U}$		30	0.03	$2.1 \times 10^2$
$^{233}\text{U}$		100	0.1	$9.5 \times 10^{-2}$
$^{234}\text{U}$		100	0.1	$6.2 \times 10^{-2}$
$^{235}\text{U}$		100	0.2	$2.1 \times 10^{-2}$
$^{236}\text{U}$		200	0.2	$6.3 \times 10^{-2}$
$^{238}\text{U}$		Unlimited.	Unlimited.	$3.3 \times 10^{-2}$
$^{235}\text{U}$ (natural)		Unlimited.	Unlimited.	(SEE TABLE A-4)
$^{235}\text{U}$ (enriched) < 20%	Unlimited.	Unlimited.	(SEE TABLE A-4)	
20% or greater	100	0.1	(SEE TABLE A-4)	
$^{238}\text{U}$ (depleted)	Unlimited.	Unlimited.	(SEE TABLE A-4)	
$^{48}\text{V}$ (irradiated)***	Vanadium (23)	6	6	$1.7 \times 10^2$
$^{181}\text{W}$	Tungsten (74)	200	100	$5.0 \times 10^2$
$^{185}\text{W}$		1000	25	$9.7 \times 10^{-2}$
$^{187}\text{W}$	Xenon (54)	40	20	$7.0 \times 10^2$
$^{127}\text{Xe}$ (uncompressed)*		70	70	$2.8 \times 10^2$
$^{127}\text{Xe}$ (compressed)*		5	5	$2.8 \times 10^2$
$^{131}\text{Xe}$ (compressed)*		10	10	$1.0 \times 10^2$
$^{131}\text{Xe}$ (uncompressed)*		100	100	$1.0 \times 10^2$
$^{133}\text{Xe}$ (uncompressed)*		1000	1000	$1.9 \times 10^2$
$^{133}\text{Xe}$ (compressed)*		5	5	$1.9 \times 10^2$
$^{135}\text{Xe}$ (uncompressed)*		70	70	$2.5 \times 10^2$
$^{135}\text{Xe}$ (compressed)*	2	2	$2.5 \times 10^2$	
$^{87}\text{Y}$	Yttrium (39)	20	20	$4.5 \times 10^2$
$^{90}\text{Y}$		10	10	$2.5 \times 10^2$
$^{91\text{m}}\text{Y}$		30	30	$4.1 \times 10^2$
$^{91}\text{Y}$		30	30	$2.5 \times 10^2$
$^{92}\text{Y}$		10	10	$9.5 \times 10^2$
$^{93}\text{Y}$		10	10	$3.2 \times 10^2$
$^{169}\text{Yb}$		Ytterbium (70)	80	80
$^{175}\text{Yb}$	400		25	$1.8 \times 10^2$
$^{65}\text{Zn}$	Zinc (30)	30	30	$8.0 \times 10^2$
$^{69\text{m}}\text{Zn}$		40	20	$3.3 \times 10^2$
$^{69}\text{Zn}$		300	20	$5.3 \times 10^2$
$^{93}\text{Zr}$	Zirconium (40)	1000	200	$2.5 \times 10^{-2}$
$^{95}\text{Zr}$		20	20	$2.1 \times 10^2$
$^{97}\text{Zr}$		20	20	$2.0 \times 10^2$

\* For the purpose of Table A-1, compressed gas means a gas at a pressure which exceeds the ambient atmospheric pressure at the location where the containment system was closed.

\*\* The values of  $A_1$  and  $A_2$  must be calculated in accordance with the procedure specified in Appendix A, paragraph II(3), taking into account the activity of the fission products and of the uranium-233 in addition to that of the thorium.

\*\*\* The values of  $A_1$  and  $A_2$  must be calculated in accordance with the procedure specified in Appendix A, paragraph II(3), taking into account the activity of the fission products and plutonium isotopes in addition to that of the uranium.

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TABLE A-4.—ACTIVITY-MASS RELATIONSHIPS  
FOR URANIUM/THORIUM

Thorium and uranium enrichment <sup>1</sup> wt % <sup>235</sup> U present	Specific activity	
	Ci/g	g/Ci
0.45.....	$5.0 \times 10^{-1}$	$2.0 \times 10^0$
0.72 (natural).....	$7.08 \times 10^{-1}$	$1.42 \times 10^0$
1.0.....	$7.6 \times 10^{-1}$	$1.3 \times 10^0$
1.5.....	$1.0 \times 10^{-0}$	$1.0 \times 10^0$
5.0.....	$2.7 \times 10^{-0}$	$3.7 \times 10^0$
10.0.....	$4.8 \times 10^{-0}$	$2.1 \times 10^1$
20.0.....	$1.0 \times 10^{-1}$	$1.0 \times 10^1$
35.0.....	$2.0 \times 10^{-1}$	$5.0 \times 10^1$
50.0.....	$2.5 \times 10^{-1}$	$4.0 \times 10^1$
90.0.....	$5.8 \times 10^{-1}$	$1.7 \times 10^1$
93.0.....	$7.0 \times 10^{-1}$	$1.4 \times 10^1$
95.0.....	$9.1 \times 10^{-1}$	$1.1 \times 10^1$
Natural Thorium.....	$2.2 \times 10^{-1}$	$4.6 \times 10^0$

<sup>1</sup> The figures for uranium include representative values for the activity of the uranium-234 which is concentrated during the enrichment process. The activity for Thorium includes the equilibrium concentration of Thorium-230.

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TABLE A-2

RELATIONSHIP BETWEEN  $A_1$  AND  $E_{max}$  FOR BETA EMITTERS

$E_{max}$ (MeV)	$A_1$ (Ci)
< 0.5	1000
0.5 - < 1.0	300
1.0 - < 1.5	100
1.5 - < 2.0	30
$\geq 2.0$	10

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TABLE A-3

RELATIONSHIP BETWEEN  $A_3$  AND THE ATOMIC NUMBER OF THE RADIONUCLIDE

$A_3$			
Atomic Number	Half-life less than 1000 days	Half-life 1000 days to $10^6$ years	Half-life greater than $10^6$ years
1 to 81	3 Ci	.05 Ci	3 Ci
82 and above	.002 Ci	.002 Ci	3 Ci

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UNITED STATES NUCLEAR REGULATORY COMMISSION  
RULES and REGULATIONS

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

**PART  
71**

**PACKAGING AND TRANSPORTATION OF RADIOACTIVE MATERIAL**

**PROPOSED RULE MAKING**

50 FR 13797  
Published 4/8/85  
Comment period expires 7/8/85

*Licenses and Radiation Safety  
Requirements for Well-Logging  
Operations*

See Part 39 Proposed Rule Making

50 FR 32086  
Published 8/8/85  
Extended comment period expires  
10/9/85.

*Licenses and Radiation Safety  
Requirements for Well-Logging  
Operations*

See Part 39 Proposed Rule Making

50 FR 45628  
Published 11/1/85

*Authority for the Copying of Records  
and Retention Periods for Security  
Records*

See Part 19 Proposed Rule Making

52 FR 7432  
Published 3/11/87  
Comment period expires 4/10/87.

*Completeness and Accuracy of  
Information*

See Part 30 Proposed Rule Making

52 FR 41442  
Published 10/28/87  
Comment period expires 12/28/87.

*Retention Periods for Records*

See Part 4 Proposed Rule Making

UNITED STATES NUCLEAR REGULATORY COMMISSION  
RULES and REGULATIONS

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

**PART  
71**

PACKAGING AND TRANSPORTATION OF RADIOACTIVE MATERIAL

PETITIONS FOR RULE MAKING

40 FR 43517

Published 9/22/75

Comment Period expires 11/21/75

[Docket No. PRM-71-1]

ENERGY RESEARCH AND  
DEVELOPMENT ADMINISTRATION

Filing of Petition for Rule Making

Notice is hereby given that the Energy Research and Development Administration has filed with the Nuclear Regulatory Commission a petition for rule making to amend the Commission's regulation "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions," 10 CFR Part 71.

The petitioner requests the Commission to initiate a rule making action to amend §§ 71.7 and 71.10 of 10 CFR Part 71 to exempt from the requirements of Part 71 "low specific activity material" as defined in § 71.4(g).

The petitioner states that the Department of Transportation Hazardous Materials Regulations, 49 CFR 170-189, provide a specific exemption for low specific activity material in which these materials are exempted from the normal Type A and Type B packaging requirements and that this exemption is consistent with both the 1967 regulations of the International Atomic Energy Agency, and the 1973 revised edition of the IAEA regulations.

A copy of the petition for rule making is available for public inspection in the Commission's Public Document Room, 1717 H Street, N.W., Washington, D.C. A copy of the petition may be obtained by writing the Division of Rules and Records at the below address.

All interested persons who desire to submit written comments or suggestions concerning the petition for rule making should send their comments to the Division of Rules and Records, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, on or before November 21, 1975.

41 FR 19920

Published 4/15/76

Comment Period expires 6/14/76

[Docket No. PRM-71-2]

AMERICAN NATIONAL STANDARDS  
INSTITUTE COMMITTEE N14

Filing of Petition for Rule Making

Notice is hereby given that Mr. Arthur Spiegelman, by letter dated March 10, 1976, on behalf of the American National Standards Institute Committee N14 on the Packaging and Transportation of Radioactive and Fissile Materials, has filed with the Nuclear Regulatory Commission a petition for rule making to amend the Commission's regulation "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions," 10 CFR Part 71.

The petitioner requests the Commission to initiate a rule making action to amend §§ 71.7 and 71.10 of 10 CFR Part 71 to exempt from the specification container requirements of 10 CFR Part 71 "low specific activity material," as defined in § 71.4(g), transported in the "sole use" mode.

The petitioner states that the regulations of the Department of Transportation in 49 CFR 173.392(b) provide an exemption for low specific activity material from the specification packaging, marking, and labeling requirements for sole use surface transport provided that the requirements of 49 CFR 173.392 (c) or (d) are met.

The petitioner states also that the American National Standards Institute Subcommittee N 14.9 on the packaging and transportation of radioactive wastes has prepared a draft of a standard on the packaging and transportation of liquid aqueous radioactive wastes, but the inconsistency between DOT and NRC regulations has presented difficult problems in trying to reach a national consensus on this matter.

A copy of the petition for rule making is available for public inspection in the Commission's Public Document Room, 1717 H Street, N.W., Washington, D.C. A copy of the petition may be obtained by writing to the Division of Rules and Records, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

All interested persons who desire to submit written comments or suggestions concerning the petition for rule making should send their comments to the Office of the Secretary, ATTN: Docketing and Service Section, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, on or before June 14, 1976.

41 FR 50359

Published 11/15/76

Comment Period expires 1/14/77

[Docket No. PRM-71-3]

DIAGNOSTIC ISOTOPES CORP.

Filing of Petition for Rulemaking

Notice is hereby given that Mr. James J. Finn, President, Diagnostic Isotopes, Incorporated, by letter dated October 1, 1976, has filed with the Nuclear Regulatory Commission a petition for rule making to amend the Commission's regulation "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions," 10 CFR Part 71.

The petitioner requests the Commission to initiate a rulemaking action to amend Appendix C of Part 71 to include the radionuclide lead-201 in Transport Group IV.

The petitioner states that lead-201 is closely associated with thallium-201 which is presently listed in Group IV of Appendix C and due to the short half-lives of these nuclides, the time for transportation of lead-201 can be utilized for the build-up of thallium-201, which isotope is useful in clinical diagnosis. The petitioner also states that the toxicity and relative potential hazard in transport for lead-201/thallium-201 is low.

A copy of the petition for rule making is available for public inspection in the Commission's Public Document Room, 1717 H Street, N.W., Washington, D.C. A copy of the petition may be obtained by writing to the Division of Rules and Records, Office of Administration, Nuclear Regulatory Commission, Washington, D.C. 20555.

All interested persons who desire to submit written comments or suggestions concerning the petition for rule making should send their comments to the Office of the Secretary, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Docketing and Service Branch, on or before January 14, 1977.



## PART 71 • PETITIONS FOR RULE MAKING

42 FR 5140  
Published 1/27/77  
Comment Period expires 2/28/77

[Docket No. FRM-71-41]

### CHEM-NUCLEAR SYSTEMS, INC.

#### Filing of Petition for Rule Making

Notice is hereby given that the Chem-Nuclear Systems, Inc., P.O. Box 1886, Bellevue, Washington, by letter dated November 22, 1976, has filed with the Nuclear Regulatory Commission a petition for rule making to amend the Commission's regulation "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions", 10 CFR Part 71.

The petitioner requests the Commission to amend §§ 71.7 and 71.10 of 10 CFR Part 71 to exempt from the specification container requirements of Part 71 "low specific activity material" as defined in § 71.4(g). The petitioner states that § 71.4(g) defines the term "low specific activity material" using the same language provided in § 171.389 of the Department of Transportation (DOT) Hazardous Materials Regulations, 49 CFR Parts 170-189, and that the DOT regulations provide a specific exemption for "low specific activity material" from the type A and type B packaging requirements. The petitioner states that this exemption is consistent with both the 1967 regulations of the International Atomic Energy Agency and the 1973 revised edition of the IAEA regulations.

A copy of the petition for rule making is available for public inspection in the Commission's Public Document Room, 1717 H Street, N.W., Washington, D.C. A copy of the petition may be obtained by writing to the Division of Rules and Records, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

All interested persons who desire to submit written comments or suggestions concerning the petition for rule making should send their comments to the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Docketing and Service Branch, by March 28, 1977.

42 FR 61089  
Published 12/1/77  
Comment period expires 1/30/78

[Docket No. FRM-71-4]

### CRITICAL MASS ENERGY PROJECT, ET AL.

#### Filing of Petition for Rule Making

Notice is hereby given that Mr. Richard P. Pollock, Director of the Critical Mass Energy Project, by letter dated October 31, 1977, on behalf of the Critical Mass Energy Project, the Honorable Theodore S. Weiss, the Honorable Timothy E. Wirth, the California Citizen Action Group, Community Action Research Group of Ames, Iowa, Environmental Action of Colorado, Massachusetts Public Interest Research Group, Michigan Public Interest Research Group, National Intervenors, Inc., New York Friends of the Earth, New York Public Interest

Research Group, North Carolina Public Interest Research Group, Southwest Research and Information Center, and Vermont Public Interest Research Group, has filed with the Nuclear Regulatory Commission a petition for rule making to amend the Commission's regulations.

The petitioners request the Commission to adopt regulations which, at a minimum, impose the following conditions on its licensees:

1. The use of special routes for the transportation of radioactive materials of all types to insure that such shipments avoid densely populated areas and mountainous terrain.

2. The adoption of emergency plans for transportation accidents involving their cargo, including (a) the organization of emergency response units to carry out the plan and (b) semi-annual drills with local and State law enforcement officials.

3. The assumption by licensees of financial responsibility for any shipping accident that involves the dispersal of their radioactive cargo.

4. A plan for informing the drivers of the vehicles about the nature of the material they are shipping and emergency actions they should undertake in the event of an accident.

The petitioners state that the regulations should require that all licensees be in compliance with the regulations within 60 days of their promulgation and that each licensee be required to demonstrate to the Commission within 60 days after the effective date of the regulations that the licensee possesses the capability to deploy emergency response units promptly to an accident scene and to otherwise carry out its plan successfully. The petitioners state also that the proposed regulations would place on each licensee the responsibility of requiring the shipper of the licensee's nuclear material to adopt the licensee's emergency plan, including taking special routes to avoid densely populated regions and mountainous terrain.

As a basis for the requested action the petitioners state that experts both inside and outside the Federal Government have concluded that there is a need for emergency response plans to protect the public in the event of an accident in transporting radioactive materials. The petitioners also state that although there has not yet been a transportation accident resulting in widespread injury to the public, the experience of the recent accident in southeastern Colorado shows that the present system is wholly inadequate to deal with the risk to the public health from a transportation accident, and that regulations by the Commission are essential. The petitioners state further that the Commission requires nuclear power reactor licensees to adopt emergency response plans, but there is no similar requirement for licensees of nuclear materials to be transported, even though a transportation accident would involve shippers and localities

wholly unfamiliar with radioactive materials.

A copy of the petition for rule making is available for public inspection in the Commission's Public Document Room, 1717 H Street, N.W., Washington, D.C. A copy of the petition may be obtained by writing to the Division of Rules and Records, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

All persons who desire to submit written comments or suggestions concerning the petition for rule making should send their comments to the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Docketing and Service Branch by January 30, 1978.



## PART 71 • PETITIONS FOR RULE MAKING

**ADDRESSES:** A copy of the petition for rulemaking is available for public inspection in the Commission's Public Document Room, 1717 H Street, NW, Washington, DC. A copy of the petition may be obtained by writing to the Division of Rules and Records, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, DC 20555.

All persons who desire to submit written comments or suggestions concerning the petition for rulemaking should send their comments to the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, DC 20555, Attention: Docketing and Service Branch.

**FOR FURTHER INFORMATION CONTACT:** Joseph M. Felton, Director, Division of Rules and Records, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, DC 20555, Telephone: 301-492-7211.

**SUPPLEMENTARY INFORMATION:** The petitioner states that radiography licensees are authorized by NRC to use only specific sources and source shipping containers and that (Foster Wheeler) " \* \* \* cannot register with the NRC Transportation Branch to be a user of a package unless we are also licensed to use that same package by the NRC Radioisotopes Licensing Branch."

The petitioner, an NRC Byproduct Material Licensee, states that the preparation of its written procedures concerning the use and transporting of source shipping containers (as specified in §§ 34.32 and 71.51) was accomplished without using the information required by § 71.12(b)(1)(i), yet these procedures apparently meet NRC requirements.

The petitioner further states that the documents which are maintained pursuant to § 71.12(b)(1)(i) have not proved to be needed or useful on other occasions and that "the regulation, as it pertains to our license category [Industrial Radiography Licensees], does no positive effect on the safe transportation of radioactive material and should be withdrawn."

A recently denied petition (Chem-Nuclear Systems, PRM-71-5) was filed on similar grounds; however, the petitioner states that its petition (PRM-71-6) relates to different issues.

Copies of Chem-Nuclear Systems' petition and the Commission's Notice of Denial are also available in the Public Document Room and may be obtained by writing to the Division of Rules and Records at the above address.

## PART 71 • STATEMENTS OF CONSIDERATION

### Approval of Type B, Large Quantity, and Fissile Material Packagings

On November 20, 1971, the Atomic Energy Commission published in the *FEDERAL REGISTER* (36 FR 22134) proposed amendments to 10 CFR part 71 of its regulations. The proposed amendments would provide a means for implementing the transfer of the approval of type B packagings from the Department of Transportation (DOT) to the AEC (in its regulatory function) by adding to part 71 standards and requirements for AEC approval of type B packagings, and procedures for obtaining AEC regulatory staff approval of type B, large quantity, and fissile material packagings. The transfer of the approval function for packages used by license-exempt AEC contractors is being implemented by a change in AEC manual, chapter 5201. Proposed amendments to DOT regulations, published concurrently, would require AEC approval of packagings, other than specification packagings prescribed in the DOT regulations and packagings approved by a foreign national competent authority under the 1967 regulations of the International Atomic Energy Agency, used to ship quantities of fissile material which exceed the small quantities specifically exempted by DOT regulations or to ship quantities of other radioactive material which exceed type A quantities, as defined in DOT regulations.

After consideration of the comments received and other factors involved, the Commission has adopted the amendments published for comment with the following changes:

1. The definition of "Type A quantity" in § 71.4(q) has been modified to limit Californium-252 in special form to 2 curies instead of 20 curies, to conform to that limit recently introduced into DOT regulations.

2. The general license provided in § 71.12 for shipment in DOT specification containers and in packages licensed for use by licensees has been amended to include packaging approved by a foreign national competent authority. The amendment to the DOT regulations, to be made effective concurrently, requires that packages approved by a foreign competent authority be revalidated by DOT before use in the United States.

3. In § 71.10 the period during which persons are exempted from the requirements for an AEC approval for Type B packages being used under a DOT special permit has been lengthened from 3 to 6 months after the effective date of the amendments.

Other minor corrective and editorial changes have been made.

The amended regulation permits uninterrupted use of type B containers approved under DOT special permits. Pursuant to § 71.10, an AEC licensee using a type B container under a valid DOT special permit is allowed to use that container until the AEC acts on an application for license submitted within 6

months of the effective date of the amendments or prior to the date on which the special permit expires, whichever is later. The corresponding DOT amendments, published February 14, 1973 (38 FR 4396), authorize the use of AEC-approved packagings, and provide that special permits issued by DOT will continue in effect until their stated expiration date.

AEC approval of packagings will consist of: (1) A license or license amendment issued under part 71, (2) an administrative approval issued to AEC license-exempt contractors in accordance with standards and procedures published in the AEC manual, or (3) an approval issued by the AEC's Directorate of Licensing to persons subject to DOT jurisdiction who are not AEC licensees. The latter category includes agreement State licensees, and persons who ship type B quantities or large quantities of radium.

To obtain AEC approval, all persons, other than AEC license-exempt contractors, are required to submit an application to the Chief, Transportation Branch, Directorate of Licensing, U.S. Atomic Energy Commission, Washington, D.C. 20545. The contents of the application are set forth in §§ 71.21, 71.22, 71.23, and 71.24 of 10 CFR part 71. AEC license-exempt contractors must apply for approval in accordance with the provisions of the AEC manual, chapter 5201.

Pursuant to the Atomic Energy Act of 1954, as amended, and sections 552 and 553 of title 5 of the United States Code, the following amendments to Title 10, Chapter 1, Code of Federal Regulations, part 71, are published as a document subject to codification to become effective June 30, 1973.

39 FR 20960  
Published 6/17/74  
Effective 7/17/74

### Form for Shipping Plutonium

On August 1, 1973, the Commission published in the *FEDERAL REGISTER* a notice of proposed rulemaking (38 FR 20482) that would have required that all plutonium in excess of twenty curies per package be shipped as a solid material contained within a "special form" capsule placed within a package meeting the conditions for normal form material. The effective date proposed was three years after adoption of the amendment. All interested persons were invited to submit written comments and suggestions for consideration in connection with the proposed amendment within 60 days after publication of the notice of proposed rulemaking in the *FEDERAL REGISTER*. After careful consideration of the comments received and other factors involved, the Commission has adopted the amendments as published for comment with the following changes:

(1) The proposed requirement that the inner containment vessel meet the "special form" capsule requirement has been replaced with a requirement that the inner containment vessel must maintain its integrity after the entire package has been subjected to the normal and accident test conditions prescribed by Part

71. The effect of the amended provisions is still to require double containment of the contents. A number of commenters expressed the view that while double containment of plutonium is an important safety objective, a requirement that the inner container meet the stringent performance specifications required of a "special form" capsule was unnecessary. The Commission considers it most important that solid form plutonium be doubly contained and that both barriers in the packaging maintain their integrity under normal and accident test conditions. The present packaging required for normal form material provides the outer barrier. In specifying the "inner barrier" in the proposed rule, the Commission proposed a form of encapsulation that was already defined in Part 71, with corresponding performance specifications. Since the inner containment requirements are intended to take into account the fact that the plutonium may not be in a "nonrespirable" form, the Commission has concluded that if it can be demonstrated that the inner container will maintain its integrity in the packaging after the package is subjected to the normal and accident test conditions, sufficient protection will be afforded.

(2) Solid plutonium in the following forms has been exempted from the double containment requirements: (a) Reactor fuel elements; (b) metal or metal alloy; and (c) other plutonium bearing solids that the Commission determines suitable for such exemption. Since the double containment provision compensates for the fact that the plutonium may not be in a "nonrespirable" form, solid forms of plutonium that are essentially nonrespirable should be exempted from the double containment requirement. Therefore, it appears appropriate to exempt from the double containment requirements reactor fuel elements, metal or metal alloy, and other plutonium bearing solids that the Commission determines suitable for such exemption. The latter category provides a means for the Commission to evaluate, on a case-by-case basis, requests for exemption of other solid material where the quantity and form of the material permits a determination that double containment is unnecessary.

(3) The implementation period has been extended from three to four years. Many comments suggested that the proposed three-year implementation period was not long enough, considering the necessary plant design effort, licensing, and construction of required facility modifications necessary to meet the requirements. Additional time was requested. The Commission believes that the increases in the amounts of plutonium to be shipped and the changing characteristics of plutonium will not change significantly in the next four years when compared to years beyond 1978. The four-year period for compliance should give the nuclear industry a sufficient period for implementation.

The Commission has determined, pursuant to guidelines of the Council on Environmental Quality, that this rule-making action will not significantly affect the quality of the human environment and, accordingly, makes this Negative Declaration on environmental impact. The staff's environmental Impact Appraisal supporting this declaration is available for public inspection at the



UNITED STATES NUCLEAR REGULATORY COMMISSION  
RULES and REGULATIONS  
TITLE 10, CHAPTER 1, CODE OF FEDERAL REGULATIONS - ENERGY

**PART  
71**

PACKAGING AND TRANSPORTATION OF RADIOACTIVE MATERIAL

STATEMENTS OF CONSIDERATION

31 FR 9641  
Published 7/22/66  
Effective 8/22/66

The regulations of the Atomic Energy Commission (AEC), 10 CFR Parts 30, 40, and 70, require that before the AEC approves an application for license to receive, possess, use or transfer byproduct, source, or special nuclear material, it must determine that the applicant's proposed program is adequate to protect health and minimize danger to life and property.

In 1958, the AEC adopted 10 CFR Part 71, "Regulations to Protect Against Accidental Conditions of Criticality in the Shipment of Special Nuclear Material". This regulation established procedures for approval of transport of special nuclear material, but set only limited standards. Certain small shipments under specified conditions were exempted from the licensing requirement.

On March 5, 1963, the AEC published a proposed revision of Part 71 (28 F.R. 2134), incorporating many detailed specifications regarding acceptable shipping methods. Public response to that proposed revision suggested that the detailed standards proposed might impair the growth of the industry and development of improved safety concepts and that the regulation should emphasize performance standards rather than detailed design standards. Proposed Part 72, "Protection Against Radiation in the Shipment of Irradiated Fuel Elements" (26 F.R. 8982, 28 F.R. 2142), which proposed standards and procedures for packaging and transport of irradiated solid nuclear fuel, elicited a similar public response.

On December 21, 1965, the AEC published for comment a proposed revision of Part 71 (30 F.R. 15748). The proposed revision combined the standards for unirradiated and irradiated fissile material previously proposed separately as Parts 71 and 72, and added standards and procedures for the shipment of large quantities of licensed material. It emphasized performance standards to determine the adequacy of proposed shipping methods, with the method of satisfying those performance standards left to the ingenuity of the shippers. The proposed performance standards would be compatible with those devel-

oped by the International Atomic Energy Agency during the past 2 years.

Subsequent to the publication of proposed Part 71, a Memorandum of Understanding between the Interstate Commerce Commission (ICC) and AEC was signed. In the Memorandum, the two agencies agree, subject to their respective statutory authorities, that (1) ICC will adopt appropriate regulations and requirements applicable to transport of all radioactive materials, and to shippers of all types and quantities of radioactive materials, but will avoid duplicatory standards with respect to preparation for shipments of fissile materials and large quantities of radioactive material, and (2) AEC will adopt appropriate regulations applicable to standards for the preparation for shipment of fissile material and large quantities of radioactive material and will be responsible for the adoption of regulations and requirements applicable to its licensees or contractors as may be necessary to protect against radiation and criticality hazards in the transportation of all radioactive material where shipment is outside the regulatory jurisdiction of ICC.

Under the Memorandum of Understanding, the ICC will utilize the assistance of AEC on container approvals for fissile materials and large quantities of radioactive materials. The AEC and ICC are working together to develop criteria for additional "specification containers" in order to reduce the number of special container permits issued by ICC.

Several changes have been incorporated in the regulation, as adopted, as a result of the Memorandum of Understanding, and the publication of amendments to ICC regulations on April 29, 1966 (31 F.R. 6492), covering some of the same areas covered in the notice of proposed rule making published by the AEC on December 21, 1965 (30 F.R. 15748). Thus, the following provisions that were contained in that AEC proposed rule have been omitted in the effective rule set out below:

1. Section 71.11 of the proposed rule, which would have imposed ICC requirements through AEC authority;

2. References throughout the proposed rule to transport of radioactive material by a licensee;

3. The radiation level limitations in proposed § 71.34;

4. The definitions of "milliroentgen per hour or equivalent" and "transport unit" in proposed § 71.4 (j) and (u);

5. The requirement in proposed § 71.40 (b) that a Fissile Class II package be labeled as prescribed by ICC, although the procedure for determining the minimum "radiation unit" for criticality control has been retained;

6. The requirement in proposed § 71.40 that a licensee not transport or deliver to a carrier more than 40 units of Fissile Class II packages, nor a single package with a calculated radiation unit of more than 10;

7. The requirement in proposed § 71.41(b) for Fissile Class III transport procedures to protect against commingling with other fissile material;

8. The requirement in proposed § 71.54 for routine determinations with regard to the radiation level limits, surface contamination limits, and transport procedures.

The definition of "carrier" in proposed § 71.4 has been modified to conform to usage under the Transportation of Explosives and Other Dangerous Articles Act (18 U.S.C. §§ 832-837), which is administered by the ICC.

Other significant differences from the regulation published for comment are:

1. The definition of the term "fissile material" has been restricted to those isotopes of uranium and plutonium which must now be controlled during transport to avoid criticality.

2. A requirement in proposed § 71.31 (b) which imposed a temperature standard on the materials and fabrication of packaging has been deleted. Correspondingly, the temperature to be considered for Normal Conditions of Transport set out in Appendix A has been increased from 100° F. to 130° F. This increased ambient temperature would provide for the more extreme conditions which might be encountered in normal transport.

3. The requirement in proposed § 71.31 (e) that primary coolant not circulate outside of the shielding has been deleted.

4. The lifting and tie-down device requirements in proposed § 71.31 (f) and (g) have been modified to make it clear that the standards apply only to devices which are a structural part of the packaging. The modified requirements are



## PART 71 • STATEMENTS OF CONSIDERATION

included in § 71.31 (c) and (d) set forth below.

5. The pressure design standards of the proposed § 71.32(b)-(d), including that for a pressure relief device, have been replaced by an internal pressure test to be initially performed on each individual package which will be subjected to significant internal pressure, set out in § 71.53(b).

6. The specific temperature restriction, contained in proposed § 71.33, on large quantity packages, assuming loss of coolant and cooling devices, has been omitted, as has the corresponding test requirement of proposed § 71.53(b). Temperature restrictions will be effectuated through the performance standards of §§ 71.35 and 71.36. Requirements have been included in § 71.35 set out below to assure that there will be no loss of coolant under the Normal Conditions of Transport.

7. The limitation on loss of shielding under the Hypothetical Accident Conditions (Appendix B) has been revised to specify an allowable increase in radiation levels to 1,000 milliroentgens per hour or equivalent at 3 feet from the external surface of the package.

8. The provisions relating to assumed leakage of water to and outleakage of liquids from fissile material packages in determining subcriticality in proposed § 71.37(b)(3) have been revised and redesignated § 71.33.

9. The requirement in proposed § 71.39 (a) that Fissile Class I packages be considered with other types of Fissile Class I packages has been deleted as unnecessary in view of the provision for assumed interspersed moderation.

10. The requirement in proposed § 71.51(a) for licensee quality control procedures has been replaced by a performance requirement in § 71.53(c) set out below that the licensee assure that the packaging is fabricated in accordance with the design approved by the AEC.

11. The list of items to be included in a licensee's operating procedures required by proposed § 71.51(b) has been deleted from the regulation.

Additional minor changes from the proposed rule have been incorporated in the effective rule.

The rule, set forth below, establishes packaging standards for the shipment of fissile material, both unirradiated and irradiated, and of large quantities of licensed radioactive material. The rule specifies the quantities and methods of transport which are exempt from Part 71 requirements and those which are under a general license. The exemption and general license provisions are applicable to shipments which from a safety standpoint do not require an AEC packaging evaluation. Those shipments are subject to regulation by federal transport agencies. For shipments not exempted or generally licensed, the rule prescribes the determinations which must be made with respect to packaging and shipping precautions required in order to assure nuclear safety of shipping methods.

With a few exceptions, the basic organization and standards set out below have not been changed significantly from those contained in the notice of pro-

posed rule making, issued on December 21, 1965 (30 F.R. 15748). A detailed explanation of the organization and standards of Part 71 is made in the notice of proposed rule making.

The rule set out below divides radionuclides into a number of groups, each having a comparable potential hazard in transport. These groups were derived from the International Atomic Energy Agency's Safety Series No. 6, "Regulations for the Safe Transport of Radioactive Materials," 1964 Revised Edition. The derivation of the groupings and the quantity limits assigned to those groupings have been published by the United Kingdom Atomic Energy Authority in its Health and Safety Branch Report AHSB (RP) R 23, dated 1963, by K. T. Aspinall and A. Fairbairn. This document is available from the Authority Health and Safety Branch, United Kingdom Atomic Energy Authority, 11 Charles II Street, London, S.W.1.

Published simultaneously with proposed 10 CFR Part 71 on December 21, 1965, were certain proposed amendments to 10 CFR Parts 30 and 70 (30 F.R. 15748), the basic licensing regulations for byproduct and special nuclear material, respectively, containing a reference to Part 71. Those amendments are no longer considered necessary and that notice of proposed rule making is, accordingly, withdrawn.

Pursuant to the Atomic Energy Act of 1954, as amended, and the Administrative Procedure Act of 1946, the following revision of 10 CFR Part 71 is published as a document subject to codification, to be effective 30 days after publication in the FEDERAL REGISTER.

33 FR 12821  
Published 3/26/68  
Effective 12/31/68

### Miscellaneous Amendments

On July 22, 1966, the Atomic Energy Commission published in the FEDERAL REGISTER (31 F.R. 9941) regulations for the packaging of fissile material and large quantities of licensed radioactive material, 10 CFR Part 71. The explanatory statement indicated the relationship of those regulations to the safety regulations of the Interstate Commerce Commission (ICC). Among other things, the regulations of the ICC under the Transportation of Explosives and Other Dangerous Articles Act prescribed the conditions of transport for shipments prepared in accordance with 10 CFR Part 71.

On April 1, 1967, the functions of the ICC under the Transportation of Explosives and Other Dangerous Articles Act were transferred to the Department of Transportation (DOT). The DOT has continued to apply the former ICC regulations pertaining to safety in the transportation of radioactive materials; those regulations are now known as the DOT's Hazardous Materials Regulations (49 CFR Parts 170-190, 14 CFR Part 103).

On January 20, 1968, the DOT published in the FEDERAL REGISTER (33 F.R. 750) for comment, as Notice 68-1, Docket No. HM-2, a proposed major revision of its regulations for transporting radioactive material. The DOT has given due consideration to the numerous comments received and, after consultation with the AEC and the atomic energy industry, has made modifications in the proposed requirements. On October 4, 1968, the DOT published in the FEDERAL REGISTER (33 F.R. 14918) a revision of its regulations pertaining to safety in transport of radioactive material, authorizing compliance on publication and making the amendments effective on December 31, 1968. The changes in the Commission's 10 CFR Part 71 set out below will conform 10 CFR Part 71 with the revision of the DOT regulations. Since the revision of the DOT regulations was published for public comment, the Commission has found that good cause exists for omitting notice of proposed rulemaking and public procedure thereon with respect to the following changes to 10 CFR Part 71, to correspond to the revision of the DOT regulations, as unnecessary.

One change in the DOT regulations which directly affects AEC licensees is the change from a limit of 40 radiation units to a maximum transport index of 50 in a single vehicle or storage area. To implement that change, all existing licenses which authorize Fissile Class II packages are amended by a new § 71.14 to increase the minimum number to be placed on each Fissile Class II packaged by a factor of 1.25. All holders of such licenses will receive individual notification of this amendment.

Pursuant to the Atomic Energy Act of 1954, as amended, and sections 552 and 553 of the United States Code, the following amendments of 10 CFR Part 71 are published as a document subject to codification, to be effective December 31, 1968. Compliance with these amendments is authorized on and after the date of publication in the FEDERAL REGISTER.

37 FR 3985  
Published 2/25/72  
Effective 3/26/72

### Miscellaneous Amendments to Chapter

See Part 20 Statements of Consideration.

38 FR 10437  
Published 4/27/73  
Effective 6/30/73

## PART 71 • STATEMENTS OF CONSIDERATION

Commission's Public Document Room, 1717 H Street, NW., Washington, D.C.

Pursuant to the Atomic Energy Act of 1954, as amended, and sections 853 and 853 of Title 5 of the United States Code, the following amendments to Title 10, Chapter 1, Code of Federal Regulations, Part 71, are published as a document subject to codification.

39 FR 22131  
Published 6/20/74  
Effective 6/20/74

### Broadening of General License Conditions

In the revised Memorandum of Understanding between the Atomic Energy Commission and the Department of Transportation dated March 22, 1973, the Commission agreed to evaluate package designs for fissile material and Type B and large quantities of radioactive material, and if found satisfactory, to issue approvals directly to the persons requesting the evaluation. The Department of Transportation in its regulations has authorized the use of such AEC-approved packages by any person, without the need for a DOT Special Permit, provided the packages meet certain specified requirements.

The purpose of the amendments which follow is to authorize persons holding a general or specific AEC license to use, under a general license, package designs for which a certificate of compliance or other approval has been issued by the Commission's Directorate of Licensing. A certificate of compliance would be the form by which a package approval would be issued to persons, such as Agreement State licensees, for whom AEC does not issue licenses or license amendments. This change will eliminate duplicate applications for package approvals and issuance of duplicate package approvals to licensees for package designs which are evaluated pursuant to the Memorandum of Understanding between the Atomic Energy Commission and the Department of Transportation without affecting safety in the use of the package.

The general license does not authorize the receipt, possession, or use of by-product, source or special nuclear material; such authorization must be obtained pursuant to the appropriate regulations (10 CFR Parts 30 to 38, 40 or 70). The general license also does not authorize the transportation of licensed material. Transportation by private, common, or contract carriers is subject to the requirements of the Department of Transportation (49 CFR Parts 170 to 179 and 397; 14 CFR Part 183; 48 CFR Part 146) either directly or through requirements in AEC or state regulations.

Since the amendments set forth below relate solely to minor procedural matters, good cause exists for omitting notice of proposed rule making, and public procedure thereon, as unnecessary. Since the amendments grant relief from restrictions under regulations currently in effect, they will become effective without the customary 30 day notice.

Pursuant to the Atomic Energy Act of 1954, as amended, and sections 853 and 853 of Title 5 of the United States Code, the following amendments to Title 10,

Chapter 1, Code of Federal Regulations, Part 71, are published as a document subject to codification.

40 FR 8774  
Published 3/3/75  
Effective 3/3/75

Energy Reorganization Act, Revisions to Chapter 1 to Reflect Organizational and Procedural Changes

See Part 2 Statements of Consideration.

42 FR 39364  
Published 8/4/77  
Effective 10/18/77  
Comment Period expires 10/18/77

### PART 71—PACKAGING OF RADIOACTIVE MATERIAL FOR TRANSPORT AND TRANSPORTATION OF RADIOACTIVE MATERIAL UNDER CERTAIN CONDITIONS

#### Quality Assurance Requirements for Transport Packages

AGENCY: U.S. Nuclear Regulatory Commission.

ACTION: Final rule.

SUMMARY: The Nuclear Regulatory Commission is amending its regulations for packaging of radioactive material for transportation and transportation of radioactive material. The amendments would upgrade requirements for quality assurance in the design, fabrication, assembly, testing, use, and maintenance of packages for shipping and transporting licensed radioactive material. The amendments would also revoke, subject to a timely application for re-approval, the present authority for licensees to use certain shipping casks for solid irradiated nuclear fuel which had been approved under criteria used before the current standards in these regulations were adopted.

EFFECTIVE DATE: October 18, 1977.

Note—The Nuclear Regulatory Commission has submitted this rule to the Comptroller General for such review as may be appropriate under the Federal Reports Act, as amended, 44 U.S.C. 2613. The date on which the reporting requirement of this rule becomes effective, unless advised to the contrary, accordingly reflects inclusion of the 60-day period which that statute allows for such review (44 U.S.C. 2613(c)(3)).

#### FOR FURTHER INFORMATION CONTACT:

Mr. Donald R. Hopkins, Office of Standards Development, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555; phone 301-443-8910.

SUPPLEMENTARY INFORMATION: On December 28, 1973, the Atomic Energy Commission published in the Federal Register (38 FR 28490) proposed amendments to 10 CFR Part 71 of its regulations. Interested persons were invited to submit written comments and suggestions. Further action on the proposed rule was delayed almost three years while developing acceptable methods of implementation.

#### Comments Received

##### Comments on Proposed Rule

Comments were received from persons who manufacture or use the ship-

ping packages which were the subject of the proposed amendments, and from one state regulatory agency. Most of the comments urged clarification, modification, or deletion of specific provisions of the proposed rule.

##### Comments on Proposed Specific Tests

More than half the comments were concerned with the proposed provisions of § 71.53, "Initial Determinations and Tests." The comments were varied and concerned the clarity and appropriateness of the proposed requirements and their applicability to certain types of packages. The Commission recognizes the validity of those comments and has not adopted those requirements in the amendments which follow. Further consideration will be given to such requirements after experience is gained in their application as license conditions in appropriate cases.

A number of comments were submitted with respect to the proposed addition of specific tests in § 71.54, "Routine Determinations." Many of these are reflected in the amendments adopted. Some comments noted that certain tests, and in particular those relating to pressure relief devices, should be tailored to the package design. The wording of § 71.54(h) and of "quality assurance program bases" in section 3 of Appendix E permit the tests and determinations to be fashioned around the package design and the safety function which the design features provide.

##### Comments on Identifying Responsible Individual

Some comments questioned the need to submit the title and qualifications of the individual in the applicant's organization who is responsible for assuring that packages have been prepared in accordance with all applicable requirements, as would have been required by proposed § 71.24(b). Since it is recognized that a licensee's entire management is responsible for licensed activities, the requirement has been deleted.

##### Comments on "Grandfather Clause" in § 71.61

A number of commenters misunderstood the proposed amendment of § 71.61 and judged it to retroactively impose quality assurance requirements, including records, on the construction of irradiated fuel casks fabricated during the 1961-1967 period. This is not the purpose of the amendment. Present § 71.61 has provided a "grandfather clause" authority for the use of irradiated solid nuclear fuel casks which were constructed prior to 1967 before the current packaging standards became effective. The proposed changes to § 71.61 would phase out this "grandfather clause" authority. The proposed changes deal with the design characteristics of these old casks and the extent to which those characteristics satisfy the present packaging standards. The proposed changes are unrelated to the proposed quality assurance provisions in the notice of proposed rule making.

##### Comments on Responsibility for Quality Assurance



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A number of commenters suggested that clarification be provided as to whether the package manufacturer or the licensee is responsible for providing information to the Commission on specific aspects of quality assurance, and as to who is responsible for carrying out these specific aspects of quality assurance in the manufacture and use of the package.

The licensee who is the applicant for the package approval provides the descriptions of quality assurance programs governing the manufacture and use of the package. If the package is approved by the Nuclear Regulatory Commission for use in the transportation of radioactive material, a package approval is issued which incorporates the package description and identification, its safety evaluation, and a description of the applicant's specific quality assurance provisions for design, fabrication, assembly, testing, use, and maintenance of the package. In the absence of reasons to the contrary, the package approval will be issued for use by any licensee who possesses the applicable documents incorporated by reference into the package approval, who has had his general quality assurance program approved by the Commission, and who will adhere to the conditions of the package approval. The authority for any licensee to use the package once it is approved is contained in the general license in 10 CFR Part 71, § 71.13, "General License for Shipment in DOT specification containers, in packages approved for use by another person, and in packages approved by a foreign national competent authority." The general license requires that each licensee who uses the general license register his name and certain other information with the Commission prior to the first use of the package and have a quality assurance program approved by the Commission.

A licensee who uses a package under the authority of the general license in § 71.13 must comply with the provisions of the general license. One provision of the general license, as clarified by the amendments which follow, is that the licensee use approved packages only in accordance with a quality assurance program which has been approved by the Commission. Another provision of the general license is that the package be used in accordance with the terms and conditions of the package approval. Quality assurance requirements specific to the particular package design would be specified in the package approval. A licensee's quality assurance program for the use of packages in transportation would then consist of the following:

1. The general provisions which satisfy to the extent necessary each of the applicable criteria of Appendix E of Part 71. These general provisions would apply to the use, testing, and maintenance of any package (and its design and fabrication if applicable), and such general provisions would have to be approved by the Commission; and

2. The specific provisions specified or referenced in the package approval which are applicable to the particular package design.

A licensee who delivers licensed material to a carrier for transport under

the authority of § 71.13 must be assured that the package is as described in the package approval, and that it is used, tested, and maintained in accordance with both the general and specific portions of the approved quality assurance program. While information may be submitted by any interested person to the Commission in support of an application for package approval, it is the licensee who delivers a package of radioactive material to a carrier who must assure himself and the Commission that the quality assurance program, on which approval of the package design is based, has been followed.

### COMMENTS ON GENERAL PROVISIONS IN APPENDIX E

A number of commenters suggested changes in the provisions of proposed Appendix E to Part 71, which contains the general provisions relative to all package quality assurance programs. It was observed that proposed Appendix E was patterned closely after Appendix B of 10 CFR Part 90, "Licensing of Production and Utilization Facilities." Comments were offered that transportation packages differ in many ways from nuclear facilities, and that the same quality assurance provisions should not be applied to both. However, the quality assurance provisions of proposed Appendix E are general in nature and with minor modifications are applicable to a wide variety of types of quality assurance programs. Flexibility in applying the provisions of Appendix E, section 2, "Quality Assurance Program" has been emphasized by the second paragraph of that section dealing with the importance, complexity, and other characteristics of the package or component to be controlled. While some suggested clarifications of Appendix E have been adopted, the general requirements of that Appendix, parallel to the general requirements of Appendix B of Part 90, have been retained. (Under § 71.51(d), a licensee may use a Commission approved quality assurance program, based on Appendix E of 10 CFR Part 90, which is established, maintained and executed with regard to transport packages.) As with the Part 90 requirements, more specific package quality assurance guidelines will be developed and published in the form of Regulatory Guides, beginning in FY 78. The comments which have been offered with respect to Appendix E will be further considered in connection with these guidelines.

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended, and sections 552 and 553 of Title 5 of the United States Code, the following amendments to Title 10, Chapter I, Code of Federal Regulations, Part 71, are published as a document subject to codification. The Commission invites all interested persons who desire to submit written comments or suggestions in connection with the amendments to send them to the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Docketing and Service Branch, by October 18, 1977.

Consideration will be given such submissions with the view to possible further amendments. Copies of comments may be examined in the Commission's Public Document Room at 1717 H Street NW, Washington, D.C.

43 FR 27174  
Published 6/23/78  
Effective 6/23/78

### PART 71—PACKAGING OF RADIOACTIVE MATERIAL FOR TRANSPORT AND TRANSPORTATION OF RADIOACTIVE MATERIAL UNDER CERTAIN CONDITIONS

Extension of the Implementation Period for QA Program Requirements

AGENCY: U.S. Nuclear Regulatory Commission.

ACTION: Effective rule.

SUMMARY: The U.S. Nuclear Regulatory Commission extends until January 1, 1979, the date for filing a description of a quality assurance program for transport packages. The original deadline of July 1, 1978 appeared in amendments published in the Federal Register on August 1, 1977. This extension is in response to requests from interested persons to delay implementation of the quality assurance criteria.

EFFECTIVE DATE: June 23, 1978.

FOR FURTHER INFORMATION CONTACT:

Robert J. Doda, Office of Standards Development, U.S. Nuclear Regulatory Commission, Washington, D.C., 20555, phone 301-443-6910.

SUPPLEMENTARY INFORMATION: On August 4, 1977, the Nuclear Regulatory Commission published effective amendments to its regulations in 10 CFR Part 71. These amendments included a requirement to file a description of a quality assurance (QA) program satisfying the criteria of Appendix E by July 1, 1978 (42 FR 39384). Although written comments or suggestions to these amendments were invited at that time, none were received.

The Commission has since received letters from interested persons questioning the applicability of these QA requirements to Agreement State licensees. Also, the Commission has received requests to delay implementation of the Appendix E criteria.

The Commission is in the process of addressing the question of the applicability of these QA requirements to Agreement State licensees. Because of this effort, and having considered other factors involved, the NRC has determined that a delay of 6 months in implementing the Appendix E criteria appears justified. A short-term delay will have no significant adverse effect on public health and safety because of existing specific QA provi-



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sions in Part 71 and the requirement for a QA program, which the staff imposes for approval of packagings for shipping irradiated fuel, high level waste, and plutonium. Accordingly, the Commission is amending its regulations by extending the date for filing a description of a QA program in § 71.51 to January 1, 1978.

Because this amendment relates solely to procedural matters, the Commission has found that good cause exists for omitting notice of proposed rule making, and public procedure thereon, as unnecessary. Since the amendment relieves licensees from restrictions under regulations currently in effect, it may become effective upon publication in the **FEDERAL REGISTER**.

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended, and sections 552 and 553 of Title 5 of the United States Code, the following amendment to Title 10, Chapter I, Code of Federal Regulations, Part 71 is published as a document subject to codification.

44 FR 63083  
Published 11/2/79  
Effective 12/3/79

### 10 CFR Part 71

**Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions; Shipment in Accordance With Department of Transportation Regulations**

**AGENCY:** U.S. Nuclear Regulatory Commission.

**ACTION:** Effective rule.

**SUMMARY:** The U.S. Nuclear Regulatory Commission (NRC) is amending its regulations for packaging and transportation of radioactive material. The amendments would require all shipments of radioactive materials made by NRC licensees, other than shipments subject to the regulations of the U.S. Postal Service, to be made in accordance with the regulations of the U.S. Department of Transportation. The regulations are being amended to allow the NRC to inspect the activities of its licensees involved with shipment of radioactive materials.

**EFFECTIVE DATE:** December 3, 1979.

**FOR FURTHER INFORMATION CONTACT:** Ralph J. Jones, Office of Standards Development, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555 [(301)-443-5949].

**SUPPLEMENTARY INFORMATION:** An increased number of shipments are being made each year of low specific activity materials and of type A quantities of radioactive materials. This trend is expected to continue in the future. Recently, there has also been a growing number of incidents involving the shipment of these materials. The basic cause of many transportation incidents can be attributed to the use of defective shipping containers or to improper loading and preparation of packages for shipment. After consulting with the U.S. Department of Transportation, the U.S. Nuclear Regulatory Commission has determined that there is a need to further assure that these shipments are being conducted in accordance with Federal regulations. Therefore, the NRC is amending 10 CFR Part 71 to require that all shipments of licensed material, except those shipments subject to the regulations of the U.S. Postal Service, be made in accordance with the regulations of the U.S. Department of Transportation. This change to the regulations which will not alter any substantive requirements will permit the NRC to inspect the activities of its licensees in this area and to take enforcement actions if warranted.

The Nuclear Regulatory Commission has overlapping authority with the Department of Transportation to regulate the transportation of radioactive materials. Because of the numerous transportation incidents that have occurred involving low specific activity and type A quantities of radioactive materials, a need exists for additional inspection and enforcement efforts to more fully assure that these shipments are made in accordance with Federal regulations. Augmenting the inspection and enforcement efforts of the Department of Transportation with those of the Nuclear Regulatory Commission will further assure that applicable Federal regulations are observed with respect to packaging and shipment of low specific activity and type A quantities of radioactive materials. In view of the foregoing and of the importance from the standpoint of the public health and safety of assuring that NRC licensees are in compliance with Federal regulations applicable to the packaging and shipment of radioactive material, the Commission has found that there is immediate need to increase the level of its inspection and enforcement activities in this area, that this change relates primarily to matters of Commission practice and procedures, and therefore, good cause exists for omitting notice of proposed rulemaking and public procedure thereon as contrary to the public interest. The amendments will become

effective December 3, 1979.

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended, and Sections 552 and 553 of Title 5 of the United States Code, the following amendment to Title 10, Chapter I, Code of Federal Regulations, Part 71, is published as a document subject to codification.

45 FR 20462  
Published 3/28/80  
Effective 3/28/80

### 10 CFR Part 71

**Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions; Correction of U.S. Postal Service Regulation Reference**

**AGENCY:** U.S. Nuclear Regulatory Commission.

**ACTION:** Effective rule.

**SUMMARY:** The U.S. Nuclear Regulatory Commission is correcting its regulatory references to U.S. Postal Service regulations governing the transportation of radioactive material by the U.S. Postal Service.

**EFFECTIVE DATE:** March 28, 1980.

#### FOR FURTHER INFORMATION CONTACT:

Ralph J. Jones, Office of Standards Development, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, (301) 443-5946.

**SUPPLEMENTARY INFORMATION:** In a Federal Register Notice dated November 2, 1979 (44 FR 63083), reference was made to the regulations of the U.S. Postal Service in 39 CFR Parts 14 and 15, Parts 14 and 15, however, have been deleted from Title 39. This reference was a portion of Sections 71.5, "Transportation of licensed material," and 71.7, "Exemption for certain quantities," of 10 CFR Part 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions."

Section 111.1 of 39 CFR Part 111, "General Information on Postal Service," provides as follows:

§ 111.1 *Postal Service Manual; incorporation by reference of general information on postal services.*

Section 552(a) of title 5, United States Code, relating to the public information requirements of the Administrative Procedure Act, provides in pertinent part that "... matter reasonably available to the class of persons affected thereby is deemed published in the **Federal Register** when incorporated by reference therein with the

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approval of the Director of the Federal Register." In conformity with that provision, and with 39 U.S.C. section 410(b)(1), and as provided in this part, the United States Postal Service hereby incorporates by reference in this part, Chapter I of its Postal Service Manual, a looseleaf publication published and maintained by the U.S. Postal Service, Washington, D.C. 20260.

The "Postal Service Manual" is commonly referred to as the "Domestic Mail Manual." The availability of this manual is set forth in 39 CFR 111.2 which provides:

### § 111.2 Availability of Chapter I of the Postal Service Manual.

(a) Copies of Chapter I of the Postal Service Manual are available for reference and inspection upon request at the National Headquarters and regional offices of the U.S. Postal Service and at all United States Post Offices and classified stations and branches during normal business hours. Regional offices are located in New York, Philadelphia, Memphis, Chicago, and San Francisco.

(b) A copy of Chapter I of the Postal Service Manual, together with each amendment of it, is on file with the Director, Office of the Federal Register, National Archives and Records Service, General Services Administration, at 1100 L Street, NW, Room 8401, Washington, D.C. 20408.

(c) Copies of the entire Postal Service Manual may be purchased from the Superintendent of Documents, Washington, D.C. 20402 for \$33.00. This price includes entitlement to receive, for an indefinite period, changes in the Postal Service Manual which may be published from time to time. A companion publication entitled Instructions for Mailers excerpts all portions of Chapter I which are directed to the mailing public. This publication is sold to the public on a subscription basis for \$5.00 by the Superintendent of Documents.

Section 124.3, "Radioactive Material," contained within Part 124, "Nonmailable Matter—Articles and Substances; Special Mailing Rules," of the Domestic Mail Manual, incorporates by reference United States Postal Service Publication 6, a ten page pamphlet entitled "Radioactive Materials." The provisions of this document track the U.S. Department of Transportation (DOT) regulations governing the transportation of limited quantities of radioactive materials and are periodically revised to be consistent with the DOT regulations on this subject. Copies of Publication 6 are available from the U.S. Postal Service, Eastern Area Supply Center, Somerville, New Jersey 08877.

Accordingly, §§ 71.5 and 71.7 of 10 CFR Part 71 are being amended to revise their reference to the regulations of the U.S. Postal Service to read "Postal Service Manual (also known as Domestic Mail Manual), section 124.3, incorporated by reference, 39 CFR 111.1 (1974)." Inasmuch as these amendments are of a minor, corrective nature, good cause exists for omitting notice of

proposed rulemaking, and public procedure thereon, as unnecessary, and for making the amendments effective on March 28, 1980.

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended, and sections 552 and 553 of title 5 of the United States Code, the following amendments of Title 10, Chapter 1, Code of Federal Regulations, Part 71, are published as a document subject to codification.

47 FR 596  
Published 1/6/82  
Effective 7/6/82

### 10 CFR Part 71

#### Advance Notification to States of Transportation of Certain Types of Nuclear Waste

**AGENCY:** Nuclear Regulatory Commission.

**ACTION:** Final rule.

**SUMMARY:** The Commission is amending its regulations to implement a federal statute which requires the NRC to promulgate regulations providing for timely notification to the governor of any state prior to transport of certain types of nuclear waste, including spent fuel, to, through, or across the boundary of that state. This notification provides the governor advance information, not otherwise available to the governor, related to nuclear waste transportation in his state. Shipment of spent fuel is covered under a separate amendment to the Commission's regulations on the physical protection of plants and materials since information regarding these shipments contains sensitive safeguards data which must be protected.

**EFFECTIVE DATE:** July 6, 1982.

**FOR FURTHER INFORMATION CONTACT:** John P. Roberts, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555 (Telephone: 301-427-4205).

**SUPPLEMENTARY INFORMATION:**

#### Background

Section 301(a) of Pub. L. 96-295 requires the Nuclear Regulatory Commission to

Promulgate regulations providing for timely notification to the Governor of any State prior to the transport of nuclear waste, including spent nuclear fuel, to, through, or across the boundaries of such State. Such notification requirement shall not apply to nuclear waste in such quantities and of such types as the Commission specifically determines do not pose a potentially

significant hazard to the health and safety of the public.

On December 9, 1980, the NRC published a Federal Register notice (45 FR 81058) inviting public comments on a proposed rule providing for advance notification to governors of states of the transportation of nuclear waste. The 90-day comment period expired March 9, 1981. Copies of the proposed rule with a request for comments were also sent to state governors. The final rule is essentially the same as the proposed rule except that its scope has been restricted to cover only large quantity (defined in § 71.4(f) as exceeding Type B radioactivity limits) shipments of radioactive waste and spent fuel not covered under advance notification provisions of 10 CFR Part 73.

#### The Rule

The Commission and the Department of Transportation (DOT) have established packaging standards for packages for various quantities of radioactive material to provide for adequate safety of the public. There are two basic categories of packages, Type A and Type B. Type A packages must be designed to withstand the rigors of normal transport but are not designed to withstand transport accidents. Therefore, the quantities and types of radioactive material which may be transported in Type A packages are limited so that, if material release occurs in an accident, no significant hazard to public health and safety would result. Type B packages, which contain larger quantities of radioactive material, are designed to withstand both the normal conditions of transport and specific accident conditions. While limits are set for Type B quantities of radioactive materials, there are no quantity limits for radioactive material per se in Type B containers. Accordingly, quantities larger than Type B, designated large quantities, may also be transported in Type B containers. However, regulatory requirements, which set limits on such factors as weight, volume, decay heat generation, and criticality control, place practical restrictions on the contents of Type B containers.

The NRC has recently affirmed the adequacy with respect to safety of existing 10 CFR Part 71 in its Withdrawal of Advance Notice of Rulemaking, "Radioactive Material Packaging and Transportation by Air," (46 FR 21619, April 13, 1981). In reaching this conclusion, it cited NUREG-0170, the Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes, which, after considering the types and quantities of materials shipped in Type A and Type B and large quantity packaging, states that the potential risk



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of transportation is small.

Radioactive material shipments, including spent fuel shipments, were considered in NUREG-0170 and are subject to the NRC regulations in 10 CFR Part 71 which the Commission found to be adequate with respect to transportation safety. However, the Congress in Section 301(a) of Pub. L. 96-295 has specifically required prenotification for spent fuel shipments. Thus, while Congress leaves to the Commission's judgment, on the basis of potential significant hazard to public health and safety, which types of nuclear waste may be excluded from prenotification, it has also made it clear that at least one type of material, spent fuel, is not to be excluded. Shipments of spent fuel are almost all large quantity (defined in § 71.41(f) as exceeding Type B radioactivity limits) shipments. Almost all spent fuel shipments will contain in excess of 100 grams mass of spent fuel and will be covered under the amendment to 10 CFR Part 73.

At the present time, all large quantity shipments of radioactive waste, excluding spent fuel, are of low level waste. In the future, should reprocessing of power reactor spent fuel resume, shipments of solidified high level waste would be expected to occur. Such shipments would be expected to be in large quantities, and the characteristics of such high level waste would be similar, in terms of radioactivity and heat load, to spent fuel.

After reviewing the data on radioactive waste shipments which is currently available, the Commission has determined that its conclusion on the adequacy of existing 10 CFR Part 71, with respect to the safety of radioactive material transportation should be reaffirmed. It also has determined that, in accordance with the intent of Congress in Section 301 of Pub. L. 96-295, for shipments of radioactive waste which include large quantities of radioactive waste and spent fuel required to be shipped in Type B packaging, prenotification shall be required. Shipments of all other types of radioactive materials do not pose a potentially significant hazard to the public health safety, and such types of materials are excluded from shipment prenotification requirements.

The NRC also recognizes that, while the term "large quantity" may be eliminated as a result of proposed rulemaking to revise regulations for the transportation of radioactive material to make them compatible with those of the International Atomic Energy Agency ("Packaging of Radioactive Material for Transportation and Transportation of Radioactive Material Under Certain Conditions, Compatibility with IAEA Regulations," 44 FR 48234, at 48238,

August 17, 1979), this revision will address types and quantities of radioactive materials presently covered under these regulations so that no purpose would be served at this time in attempting in this rulemaking to separately redefine the term "large quantity" for advance notification.

In accordance with the intent of Congress and consistent with the Commission's determination that shipments of radioactive waste do not pose a potentially significant hazard to the health and safety of the public, the Commission is amending its regulations in 10 CFR Part 71 to require NRC licensees to notify state governors in advance of all large quantity shipments of radioactive waste and of spent fuel not covered under the amendment to 10 CFR Part 73 (generally 100 grams mass or less) required to be shipped in Type B packaging.

Advance notification requirements for spent fuel shipments in excess of 100 grams mass are being addressed by the Commission in a separate rulemaking action in 10 CFR Part 73 for safeguards purposes. A companion notice covering this action is published elsewhere in this issue of the Federal Register. Shipments of large quantities (defined in § 71.4(f) as exceeding Type B radioactivity limits) of radioactive waste, including spent fuel not subject to 10 CFR Part 73 (approximately 100 gram mass or less) are covered in this amendment to 10 CFR Part 71.

The amendment to 10 CFR Part 71 will require licensees to supply the following information: the name, address, and telephone number of the shipper, carrier and receiver of the shipment, a description of the material to be transported, point of origin, estimated period of departure, estimated periods of arrival at state boundaries, the destination of the shipment, the estimated period of arrival, and a point of contact for current shipment information. This information would be provided by mail postmarked at least seven days or delivered by messenger at least four days in advance of the estimated period of departure, to the offices of the governors of affected states or their designees. A new information requirement contained in a recent DOT rulemaking ("Radioactive Material: Routing and Driver Training Requirements," 46 FR 5326, January 19, 1981) may lessen the impact of this amendment since shippers are on notice that they may need to develop procedures for reporting to DOT and can arrange to extend this effort to include NRC. The DOT Final Rule "Radioactive Materials: Routing and Driver Training Requirements," would require that route plans for large quantity shipments be submitted to the DOT Materials

Transportation Bureau (49 CFR 173.22(c) 46 FR 5296 at 5316, January 19, 1981).

This final rule, unlike the DOT Final Rule (46 FR 5296), affects only NRC licensees, resulting, at the outset, in a situation where governors will not receive notification concerning a fraction of the total number of shipments, since some shipments of interest will be made by Agreement State licensees. This situation was anticipated, as noted in the additional views of several representatives (opposed to the requirement of section 301) appearing at page 37 of H. Rept. 96-294, Part 2 (June 29, 1979):

Further, the NRC currently licenses possession of radioactive materials in only 25 (now 24) states. Under agreements between the NRC and the remaining states, those states would also have to implement regulations under this amendment.

### The Comments

NRC received 62 letters containing more than 300 comments on the proposed rule. Comments were received from these entities as follows:

	Comments
State governors or state agencies _____	21
Individuals from public sector _____	19
Nuclear industry _____	16
Federal agencies _____	8
City mayors _____	1
<b>Total _____</b>	<b>62</b>

The comments covered three general categories: (1) the scope of the rule, (2) its impacts and (3) administrative considerations.

1. *Scope of the Rule. a. Contents of packages subject to prenotification requirement.* Comments received ranged from favoring inclusion of almost all radioactive wastes for prenotification to not promulgating any amendment at all.

Initially, the NRC contemplated that all waste required to be shipped in Type B packaging should be included. Type B packaging designs are required to be accident resistant because Type B quantities of radioactive wastes are potentially a more significant hazard to the public health and safety if they are not adequately contained. However, NRC regulatory requirements for Type B packaging have been found to be adequate. As has been noted heretofore, the NRC has recently affirmed the adequacy with respect to safety of Type B packaging in a withdrawal of Advance Notice of Rulemaking, "Radioactive Material: Packaging and Transportation by Air" (46 FR 21619, April 13, 1981). In reaching this conclusion, it cited NUREG-0170, the Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes, which, after considering the types and quantities of materials shipped in Type A and Type B and large



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quantity packaging states that the potential risk of transportation is small. Upon further consideration and review of the currently available data on radioactive waste shipments, the Commission has determined that shipments of radioactive waste do not pose a potentially significant hazard to the health and safety of the public. However, Congress has specifically required prenotification of shipments of spent fuel, which are almost always large quantity shipments, for prenotification. Accordingly, the Commission is amending the regulations in 10 CFR Part 71 to require NRC licensees to notify state governors or their designees in advance of all large quantity shipments of radioactive waste and of spent fuel not covered under the amendment to 10 CFR Part 73 required to be in Type B packaging. In the opinion of the Commission, this amendment is consistent with the intent of Congress which specifically included spent fuel, almost always shipped in large quantities, in the prenotification provisions of section 301(a) of Pub. L. 96-295, but also authorized the Commission to determine which types of radioactive waste may be excluded from prenotification requirements.

The NRC also believes that the varying concerns of the states can best be addressed by limiting NRC prenotification requirements to large quantity shipments of radioactive waste, including spent fuel. In its recent June 8, 1981 meeting, the State Planning Council on Radioactive Waste Management endorsed prenotification of high-level or large quantity shipments of radioactive materials, including spent fuel.

Finally, after consideration of comments, the NRC believes that inclusion of all shipments of Type B packaged waste is likely to cause an unwieldy paper management problem and reduce the utility of the notification system. For this reason the NRC determines that limiting advance notification to large quantity shipments will significantly reduce an undue administrative burden of notification on states and shippers. The number of shipments expected under this more restricted rule is a few hundred annually and will more likely be less than one percent of the 24,000 Type B shipments per year previously estimated in the proposed rule.

*b. Emergency preparedness concerns.* These issues are already being addressed outside this rulemaking action and therefore do not require further discussion at this time. As the Commission noted on April 13, 1981 in its Withdrawal of Advance Notice of Rulemaking (46 FR 21819),

In another separate action, the NRC, in cooperation with the Federal Emergency

Management Agency and other federal agencies is currently developing guidance material to be used by state agencies in developing emergency response plans for transportation accidents involving radioactive material.

*c. State and local authority.* Since the advance notification rule is solely informational and does not in any way preempt existing state or local authority with respect to regulation of transportation of radioactive materials, the concerns raised on the impact of the rule on state and local authority, particularly on the issue of preemption, are not germane. With respect to concerns over the failure to include Agreement State licensees under prenotification requirements, Congress did not choose to amend the Atomic Energy Act of 1954, as amended, to subject Agreement State licensees to this requirement. However, NRC plans to work with Agreement States to make regulations equivalent to this rule a matter of compatibility.

*2. Impact.* Concern was expressed over the potential impacts that the proposed amendment could have on the public health and on the safety of radioactive materials shipping. Such comment varied considerably because of widely differing views of commenters as to the present dangers to the public of radioactive waste shipping and whether a greater degree of regulation would enhance or diminish public safety. Concern was also expressed over potential problems for shipping accruing from the implementation of the proposed amendment. Potential problems raised included additional radiation exposure to the public, impeding efficient shipping, the financial and administrative burden of reporting on shippers, carriers, state agencies, and safeguards. In general, these comments indicated concern that the impact of the amendment was negative. However, with respect to safeguards, inclusion of all Type B shipments under proposed § 73.37(f) was also advocated. A third area of concern was that NRC regulations be coordinated with the Department of Transportation. This concern was generally directed toward the prospect of alleviating the administrative burden resulting from federal regulations on shipping.

The NRC has already addressed the issue of shipment safety in determining what types of wastes should be excluded from prenotification. In accordance with the provisions of section 301(a) of Pub. L. 96-295 only shipments of large quantities of radioactive waste, including spent fuel required to be shipped in Type B packaging are subject to the prenotification requirement. Under existing transportation regulations, such

shipments are placarded and information on them is not restricted from the public. Moreover, this regulation does not preempt existing state and local authority over transportation. The NRC has therefore concluded that requiring prenotification for large quantity shipments of spent fuel and radioactive waste will have negligible negative impacts on public health and safety and efficient shipping.

The Commission also believes that the exclusion from the prenotification requirement of all radioactive waste shipments except large quantities required to be shipped in Type B packaging, including spent fuel not covered under the amendment on advance notification to 10 CFR Part 73, will significantly reduce the financial and administrative burden on states, carriers, and shippers of such notification. Based on estimates contained in NUREG-0170, the Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes, in 1985 shipments of Type B wastes are expected to number 24,000 while large quantity shipments are only expected to number, at most, a few hundred annually and more probably less than one percent of the 24,000 Type B waste shipments.

With respect to coordination with the Department of Transportation, DOT announced in the preamble to its final rule on "Radioactive Materials: Routing and Driver Training Requirements" (46 FR 5298, January 19, 1981) that,

In order to prevent a possibly severe inconsistency between NRC and DOT transportation requirements, the DOT will have to wait at least until final rules are issued for NRC licensees before undertaking a rulemaking proceeding to consider specific prenotification requirements for other types of large quantity shipments.

*3. Administrative Considerations.* A number of changes which were suggested or raised for consideration in comments may be categorized as administrative in nature. These included: inclusion of route information, use of generic reporting, creation of a federal clearing-house for notification, designation of a state agency addressee for notification receipt other than the office of the governor, restrictions on notification information to be supplied, clearer definition of carrier and licensee responsibilities, requesting state acknowledgement of notification before a shipment could enter a state, additional documentation requirements related to notification, and changes in the period required prior to shipment.

With one exception, notification to a governor's designee, which will serve to facilitate state response, these comments have not been adopted in this rule. Three of these comments, inclusion

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license, certificate, or other approval

By letter dated March 10, 1980, the Foster Wheeler Energy Corporation filed a petition for rulemaking (Docket No. PRM 71-8) requesting that the Commission exempt persons licensed under 10 CFR Part 34 for industrial activities from the requirement for the general licensee to have a copy of all the documents referred to in the specific approval.

Upon consideration of the information that would contribute to safe shipment, the Commission proposed amendment of the general license so that the general licensee would not be required to have "all" referenced documents, but would be required to have those drawings and other documents which relate to the use and maintenance of the packaging and to the actions to be taken prior to shipment.

The proposed amendment provided a period of 30 days for public comment. Eleven comments were received. The comments are general in nature and support the proposed amendment.

### The Regulation

The final rule is the same as the proposed amendment. It modifies the requirement of § 71.12(b)(1)(i) that the general licensee have all documents referred to in the Commission's specific approval of the package. As modified, the regulation requires that the general licensee have those drawings and other documents relating to use and maintenance of the packaging and to the actions to be taken prior to shipment.

The final rule also amends § 71.12(c)(1) to clarify that the requirement for users of foreign-approved packages to possess documents relating to use and maintenance and preparation of the packages for use, includes an obligation to possess pertinent drawings.

### Paperwork Reduction Act Statement

The Office of Management and Budget will be notified of the reduction of a recordkeeping requirement contained in Part 71.

### Regulatory Flexibility Certification

Since this amendment reduces a present recordkeeping requirement, the Commission, in accordance with sec. 605(b) of the Regulatory Flexibility Act of 1980, 5 U.S.C. 605(b), hereby certifies that this rule will not have a significant economic impact on a substantial number of small entities. Persons using the general license in § 71.12 will be required to possess fewer documents and thus should incur a reduction of approximately 50 percent in paperwork and recordkeeping costs.

### List of Subjects in 10 CFR Part 71

Hazardous materials—transportation. Nuclear materials. Packaging and containers. Penalty, Reporting requirements.

Since the following amendment relieves rather than imposes restrictions under regulations currently in effect, it will become effective August 12, 1982, pursuant to 5 U.S.C. 553(d).

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended, and sections 552 and 553 of title 5 of the United States Code, the following amendment of Title 10, Chapter I, Code of Federal Regulations, Part 71, is published as a document subject to codification.

48 FR 35600

Published 8/5/83

Effective 9/6/83

Correction 8/24/83

### 10 CFR Part 71

#### Rule To Achieve Compatibility With the Transport Regulations of the International Atomic Energy Agency (IAEA)

**AGENCY:** Nuclear Regulatory Commission.

**ACTION:** Final rule.

**SUMMARY:** The U.S. Nuclear Regulatory Commission (NRC) is revising its regulations for the transportation of radioactive material to make them compatible with those of the International Atomic Energy Agency (IAEA) and thus with those of most major nuclear nations of the world. Although several substantive changes are made to provide a more uniform degree of safety for various types of shipments, the Commission's basic standards for radioactive material packaging remain unchanged. Some deletions from the proposed rule have been made to account for changes expected in the 1984 revision of the IAEA regulations (begun since the NRC proposed rule was issued) which will bring those regulations closer to those of the United States. These regulations apply to all NRC specific licensees who place byproduct, source, or special nuclear material into transportation. The special restriction on the air transport of plutonium has been included in this revision in its final form.

**EFFECTIVE DATE:** September 6, 1983. The information collection requirements are suspended until the Office of Management and Budget (OMB) has completed its review of the information collection requirements. In order

to minimize negative impacts through the period before this rule becomes effective, during which there are some inconsistencies between the presently effective regulations of NRC and the Department of Transportation (DOT), the NRC has adopted a policy of flexibility. In practical terms, in those situations where compliance with a new DOT requirement would be in conflict with a current 10 CFR Part 71 requirement, NRC would in most cases accept compliance with the new DOT requirement. NRC would reserve judgement, however, to take enforcement action in an appropriate case.

**ADDRESSES:** Single copies of the value/impact analysis for this rule change may be obtained on request from the contact identified below. Copies of the value/impact analysis and of the

Commission's analysis of public comments may be examined and copied for a fee in the Commission's Public Document Room at 1717 H Street NW., Washington, DC.

**FOR FURTHER INFORMATION CONTACT:** Donald R. Hopkins, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555. Telephone 301-443-7825.

### SUPPLEMENTARY INFORMATION:

#### Background

On August 17, 1979, the Nuclear Regulatory Commission published in the Federal Register (44 FR 45234) a proposed revision of 10 CFR Part 71 of its regulations pertaining to the transportation of radioactive material. Interested persons were invited to submit written comments and suggestions on the proposal and/or the supporting value/impact analysis by October 16, 1979. The public comment period was subsequently extended to December 17, 1979. Based on the public comments and other considerations, the Commission has adopted the proposed revision, with modifications as set forth below. The regulations apply to all NRC licensees who place byproduct, source, or special nuclear material into transportation.

The revision, as proposed, in combination with a corresponding amendment of Title 49 of the Code of Federal Regulations by the Department of Transportation (DOT), would bring the U.S. regulations into accord with relevant portions of the International Atomic Energy Agency (IAEA) design and performance requirements to the extent considered feasible, thereby making U.S. regulations compatible with the domestic regulations of most of the international community.

One important change proposed was a change in the system used to specify the quantities of radioactive materials permitted in packages (designated Type A packages) not required to survive severe transportation accidents. These quantities, derived from criteria limiting



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of route information, use of generic reporting, and the creation of a federal clearinghouse for reporting information were substantially resolved in the recent DOT rulemaking on "Radioactive Materials: Routing and Driver Training Requirements" (46 FR 5298, January 19, 1981), the preamble to this final DOT rule states in part.

Also a provision is added to § 173.22(c) to require shippers of a large quantity package of radioactive materials to file a copy of the route plan prepared for that shipment within 60 days following the shipment with DOT. The Department intends to consolidate the information contained in the route plans and supply it to interested parties.

This effort by DOT to obtain post-shipment information is likely to provide greater accuracy in such reporting, and any NRC efforts would be largely duplicative.

The Commission believes that proposals on restricting information to be supplied in reporting would be confusing and burdensome. Provision for some state governors to decline to receive prenotification would also be a burden to licensees. Governors are not required to take any action on prenotifications received and are free to dispose of them since they will not contain protected information that Part 73 prenotifications will. Provision for receipt of partial information, which was also suggested, would result in increased paperwork since, for a single shipment, different amounts of information would be required for different states and militate against use of a standard reporting form. As already noted, summary information is expected to be available from DOT as a result of its highway routing rule. In addition, NRC staff plans to forward to DOT advance notifications received for DOT's data base. Another restriction suggested, requiring a state to reapply periodically for continued receipt of notification, does not comport with congressional intent in section 301 of Pub. L. 96-295.

The text of § 71.5a makes it clear that responsibility for advance notification of a shipment of nuclear waste, as defined in § 71.4(r), rests with the licensee, i.e., the shipper, not the carrier. Requiring shippers to await state acknowledgement of notifications would likely impede interstate shipping and could burden interstate commerce by effectively excluding shipments from states which did not choose to establish means of promptly acknowledging such notifications. With regard to suggestions that would require additional documentation from licensees, such as, for example, requiring licensees to document telephoned notification changes by letter, the NRC concludes that the additional burden on industry and states is not worth such effort. No

change has been made in the period of time within which advance notification of a shipment must be given. A shorter period would tend to reduce the effectiveness of notification by mail and a longer period does not seem necessary. Basing the period on arrival at individual state boundaries rather than shipment departure would result in multiple and differing notifications for a single shipment which would require additional effort and possibly contribute to confusion in reporting.

### Environmental Impact Statement

In accordance with 10 CFR 81.8(d)(3), an environmental impact statement, negative declaration, or environmental impact appraisal need not be prepared in connection with this rulemaking action because the amendments are nonsubstantive and insignificant from the standpoint of environmental impact.

### Paperwork Statement:

The Nuclear Regulatory Commission has submitted this rule to the Office of Management and Budget for such review as may be appropriate under the Paperwork Reduction Act, Pub. L. 96-511, The SF-83, "Request for Clearance," Supporting Statement, and other related documentation submitted to OMB have been placed in the NRC Public Document Room at 1717 H Street NW., Washington, DC 20555 for inspection and copying for a fee.

After careful consideration of the comments on the proposed rule, the Commission, for the reasons set out in the preamble and pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended, Section 301 of Pub. L. 96-295 (94 Stat. 789-790), and Sections 552 and 553 of Title 5 of the United States Code, has adopted the following amendments to 10 CFR Part 71 which are published as a document subject to codification.

47 FR 34970  
Published 8/12/82  
Effective 8/12/82

### 10 CFR Part 71

#### General License for Shipment in Packages Approved for Use by Another Person

AGENCY: Nuclear Regulatory Commission.

ACTION: Final rule.

SUMMARY: The Nuclear Regulatory Commission is amending its regulations concerning the transportation of radioactive material. Specifically, it is

changing the recordkeeping requirements of the general license authorizing an NRC licensee to use a package that the Commission has previously evaluated and specifically authorized another licensee to use. Previously, as a condition of the general license, the general licensee was required to possess copies of all documents referred to in the Commission's specific authorization. This amendment will require the general licensee to possess only those drawings and other documents relating to the use and maintenance of the packaging and to the actions to be taken prior to shipment.

EFFECTIVE DATE: August 12, 1982.

FOR FURTHER INFORMATION CONTACT: Mr. Donovan A. Smith, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, Telephone (301) 443-5825.

SUPPLEMENTARY INFORMATION: On May 18, 1982, the Nuclear Regulatory Commission published in the Federal Register (47 FR 21269) a notice of proposed amendment to 10 CFR Part 71 to modify the recordkeeping requirements of the general license in § 71.12 for shipment in packages specifically approved by the Commission or by a foreign national competent authority. The amendment to § 71.12 pertains only to the documents which users of the general license must possess.

### Background

In 1970 the U.S. Atomic Energy Commission (AEC) amended its transportation regulations to provide a general license for persons shipping licensed material in packages which the Commission had previously evaluated, found to meet the standards of Part 71, and specifically authorized another licensee to use.

The general license procedure adopted in 1970 provided authority for any AEC licensee to use any package which had been specifically licensed by the AEC if the general licensee (1) had a copy of the specific licensee and related documents authorizing use of the type of package, (2) complied with the terms and conditions of the specific license, and (3) notified the AEC of the specific licensee's name and license number and the model number of the packaging.

The general license published by AEC (now in § 71.12 of the NRC regulations) has been effective in reducing paperwork; however, one of its requirements has caused questions about the documents which the general licensee must possess. As a condition of the general license, the general licensee has been required to have a copy of all documents referred to in the



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individual radiation exposure resulting from transportation accidents, have since 1966, been based on grouping all radionuclides in seven transport groups and limiting all radionuclides in the group according to the toxicity of the most hazardous member. There was, in addition, a "special from" category for radioactive materials which are not dispersible because of their inherent physical form or because of suitable encapsulation. This system is unnecessarily restrictive when applied to the less toxic group members, which in some cases are less than one-tenth as toxic as other group members. The proposed change would eliminate the transport groups and instead assign to each radionuclide two values,  $A_1$  and  $A_2$ , which are the maximum quantity of that radionuclide permitted in Type A packages in special form and non-special form, respectively.

The other major proposed change was to create two classifications of packages (designated Type B packages) which are resistant to transportation accidents. The two classifications are the Type B(M) package which for international shipment requires approval of the package design by the competent authority of each country into or through which the package is transported (i.e., multilateral approval) and the Type B(U) package which requires package design approval only of the country of origin (i.e., unilateral approval). Requirements for the Type B(U) package approval would be more stringent to assure that all countries affected would be satisfied with the package design as approved by the country of origin.

Other changes were proposed dealing with definitions, requirements for transporting low specific activity materials, small quantities of fissile material, and standards for leak tightness. A large number of changes were proposed to bring U.S. domestic rules as close as possible to the international standards. However, the basic systems of control remain unchanged as do the basic standards which define the required level of safety.

### Other Considerations

#### IAEA Activities

During September 1980 and March 1982, revision panels were assembled by IAEA to draft changes for the scheduled 1984 revision of its transportation regulations. Decisions made by these revision panels, consisting of representatives of most major countries involved in nuclear material transportation, would make IAEA regulations more compatible with present U.S. regulations. NRC, in consultation with DOT, has decided not to include in its final revision of 10 CFR

Part 71 those requirements introduced in the IAEA regulations in 1973 which are expected to be removed from IAEA regulations in the 1984 revision. This results in elimination of the "additional requirements for Type B(U) packages" in proposed § 71.34. The design criteria of § 71.34 (f) and (g) are deleted. All other distinctions between B(U) and B(M) packages are eliminated except those related to internal pressure limitations and pressure relief devices for B(U) packages, which are now contained in the definition of a Type B package.

The IAEA, as part of its effort to maintain the continued adequacy of the regulations, has adopted a modified system for determining  $A_1$  and  $A_2$  values. This new system will be incorporated in the 1984 revision of the IAEA regulations which is being-prepared. The system was adopted in principle by the IAEA at the March 1982 Advisory Group on the revision and it was subsequently refined by a special Work Group which met in August 1982. When the IAEA circulates the "3rd Draft" version of the regulations, DOT will be making it available and will seek public comment.

It has become apparent to NRC that the new system incorporates a radiological exposure pathway which has not been considered previously. This pathway involves consideration of the dose to the skin of a person contaminated with a radionuclide. For most radionuclides this is not a limiting pathway as other considerations in both the present and proposed systems are generally more limiting. Examples of the other more limiting considerations are radiation levels from unshielded material and internal pathways such as inhalation. For some beta-emitting nuclides, however, the contaminated skin consideration is limiting. In some cases the Type A limits calculated under the newly adopted system are significantly lower than the previously accepted  $A_2$  values and some are even lower than the earlier Transport Group values.

The NRC believes that it cannot ignore the contribution that the contaminated skin consideration makes toward a complete system for calculating Type A values. This is particularly true for radionuclides which have high  $A_2$  values under the 1973 IAEA regulations and would have considerably lower  $A_2$  values under the new IAEA system due to their potential for significant dose to contaminated skin. Of these radionuclides, some have values below the old transport group values (Case 1) and some have values between the old transport group and the 1973 IAEA values (Case 2).

The NRC believes that it is prudent to both accept this new pathway as

necessary to provide a complete system for setting Type A values and to minimize unnecessary fluctuations in the Type A limits. While there is some uncertainty as to the exact values which will result from the final, accepted new IAEA system, the NRC is confident that the values now available are conservative and will most probably not be lowered. Therefore, for those nuclides which are limited by the skin exposure pathway, values have been selected as follows:

Case 1: The transport group values are adopted as the new  $A_2$  values.

Case 2: The values now available are adopted in lieu of the 1973 IAEA values.

These two cases can be represented graphically as:

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concentrations small enough to present no significant hazard to the public health and safety even if the plutonium were released in an air crash. Only one public comment was received with respect to the proposed rule, and that was favorable. The final rule, as proposed, is therefore included in this overall revision of Part 71.

The original restriction on the air transport of plutonium was imposed by NRC order dated August 15, 1975. This order was imposed after the U.S. Congress, in Pub. L. 94-79, prohibited the NRC from licensing any shipments of plutonium by air until the NRC certified to the Congress that a safe container had been developed and tested which would not rupture under crash and blast-testing equivalent to the crash and explosion of a high-flying aircraft. A second order was issued on September 1, 1978, superseding the first order dated August 15, 1975, after the first air-crash resistant package, the Model PAT-1 package, had been certified by NRC to the Congress. The second order allowed the use of the PAT-1 package for the air transport of plutonium. With the finalization of this regulatory revision and the imposition of 10 CFR Part 71.86 to implement the restriction of Pub. L. 94-79, the NRC's second order dated September 1, 1978 is being revoked by the Provisions of § 71.86. However, in addition to the NRC orders, restrictive conditions were also placed in the licenses of persons authorized to possess plutonium, restricting its air shipment. Those license conditions will be automatically removed from the licenses when the licenses are processed by NRC for renewal or amendment. Any licensee who needs that license condition removed earlier should request that action. There will be no licensing fee for removal of the condition.

On October 1, 1976, Diagnostic Isotopes Incorporated petitioned the Commission to include the radionuclide lead-201 in Appendix C of 10 CFR Part 71, as a Transport Group IV radionuclide (PRM-71-3). Lead-201 decays in a short time to thallium-201 which is useful in clinical nuclear medicine. This final revision of 10 CFR Part 71 includes lead-201 in the table of radionuclides with a Type A quantity of 20 curies, thus granting the petition.

On July 18, 1977, Eberline Instrument Corporation petitioned the Commission (PRM-70-6) to approve the air transport of calibration or reference sources which contain not more than five microcuries of plutonium and which are generally licensed pursuant to 10 CFR 70.19, "General license for calibration or reference sources." Air transportation of plutonium has been prohibited by NRC order since August 15, 1975, except when the plutonium is in a medical device for individual human use, or is in a package specifically

certified by NRC as air-crash resistant. This final revision of 10 CFR 71 at § 71.86 allows the air transport of plutonium in quantities or concentrations small enough to present no significant hazard to the public health and safety even if the plutonium were released in an air crash, thus granting the petition.

### Public Comments and Detailed Considerations

There were 29 letters of comment received on the proposed revision from industry, government, and medical sources. The most common comment noted differences among NRC, DOT, and IAEA definitions and requirements where no reasons for differences were apparent. The present Memorandum of Understanding between DOT and NRC, published on July 2, 1979 (44 FR 38880), defines the types and quantities of radioactive materials to be regulated by each agency. There are some common definitions and requirements. It is important that the two sets of regulations be consistent. It is also intended that, to the extent feasible, and aside from administrative matters, both sets be substantively in accord with IAEA regulations, Safety Series No. 6. These inconsistencies have been corrected in the final rule where possible.

Detailed consideration of all public comments is contained in a document entitled "Consideration of Public Comments—Revision of 10 CFR Part 71 for Compatibility with IAEA Regulations (44 FR 48234)." This document may be examined in the Commission's Public Document Room at 1717 H Street, NW., Washington, D.C. The following is a discussion of public comments of general interest on, and significant changes in, the proposed regulations, discussed in the order in which the requirements were proposed:

#### Section 71.4 Definitions

One commenter noted that certain isotopes of americium, curium, and californium are also fissile, but not included in the definition of "fissile material." Another commenter proposed deleting plutonium-238 from the list of fissile radionuclides because, as with fissile isotopes of americium, curium, and neptunium, it is capable only of fast fissioning. The present Part 71 classification, which is also that of the IAEA, is being retained because plutonium-238 is shipped in substantial quantities, whereas available quantities of americium, curium and neptunium are so small as to be of no concern with respect to criticality in transportation.

With respect to the definition of "Type B package", the question was asked, "Are there limits on the quantity of material that can be shipped in a single Type B package?" While there are no limits specified in the regulation

there are quantity limits specified in the package design approval. These may be the limits proposed in the application for package design approval, if adequately justified, or may be lower if necessary due to heat, criticality, shielding, or other considerations. In addition, the definition of "Type B package" has been modified to more clearly specify the sole remaining technical distinctions between B(U) and B(M) packages, having to do with the internal pressure, and pressure relief devices. The definition remains different from that of IAEA which emphasizes the unilateral or multilateral approval system for international transportation. This is an administrative distinction which will be controlled through the regulations of DOT.

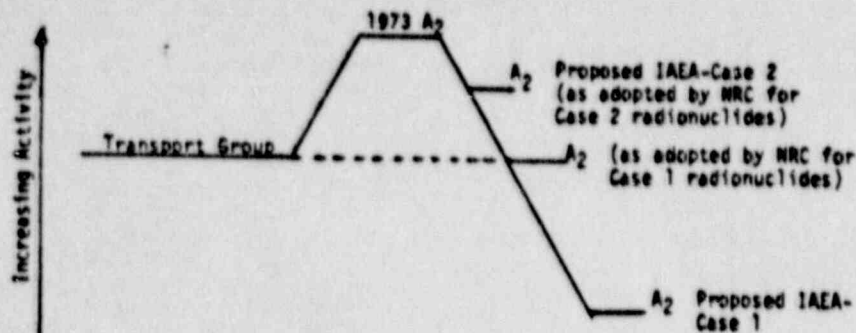
The proposed definition for special form would have required all encapsulations to be contained in a sealed capsule "which can be opened only by destructive means." This phrase was intended to clarify the IAEA requirement which states that an encapsulation must be "so constructed that it can be opened only by destroying the capsule." Comments received indicated that the IAEA wording was less subject to varying interpretations and so it has been incorporated in the definition of special form. Commenters pointed out some difficulties which would result from performing cutting and welding or brazing operations in the closed environment of a glove-box or hot cell but these objections were not quantified to any degree and are routinely performed in certain industries. It was not established by the commenters that the proposed requirement could not be met or that it would be too costly to meet the requirement.

#### Section 71.5 Transportation of licensed material

In the interest of simplicity, the references to the regulations of the U.S. Postal Service (USPS) have been removed from § 71.5. The jurisdiction of the USPS has no limitations pertinent to safety as does the DOT jurisdiction which is limited to the "transportation of hazardous materials in commerce." Anyone who uses the USPS transportation system for transportation of radioactive material is subject to the USPS regulations, the substance of which is contained in USPS Publication #6, "Radioactive Materials," dated December 1975. Single copies of that publication are available from USPS or from the contact identified in this notice. References to USPS regulations are deleted from § 71.5 but included in § 71.0(b) as a reminder that there are



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The radionuclides which are affected in Case 1 are:

Ag-111	Mo-99	Sr-90
Au-198	Nd-147	Si-31
Cd-115	Ni-149	Sm-153
Ce-143	Os-180	Ta-182m
Dy-165	Pb-109	Ta-182
Er-171	Pb-149	Tb-129
Gd-153	Pm-147	W-187
In-115m	Pm-147m	Zn-69m
	Pm-167	Zn-69
	Re-188	

The radionuclides which are affected in Case 2 are:

Au-198	Eu-155	Rh-108
Bk-247	Hf-181	Ru-103
Ca-45	Hg-203	S-35
Ca-141	I-133	Sr-90
Cl-38	In-111	Tb-160
Co-134m	Ir-192	Tc-99
Co-135	K-43	Tc-99m
Co-137	Lu-177	Th-231
Cu-64	N-13	Ti-204
Cu-67	Np-239	Tm-170
Er-169	Os-191	W-185
Eu-152	Pm-147	Yb-175
	Rb-81	

In both cases the values adopted herein are no lower than the previously existing transport group values and yet are lower than the previously proposed 1973 IAEA  $A_2$  values. For the radionuclides listed under Case 1, the  $A_2$  is set at the old limit of 20 curies as each nuclide was previously in transport group IV which had this limit. The nuclides listed in Case 2 have been assigned the currently available values under the new IAEA system. These values are between the old transport group and the 1973 IAEA values. When the new IAEA system is fully implemented by the IAEA, and the skin exposure pathway is taken into due account, then NRC expects to complete the alignment of  $A_2$  values between the U.S. and the IAEA.

It is expected that there will be a complete revision of the IAEA criteria governing the definition and transportation of low specific activity material. In anticipation of the future IAEA changes, the proposed definitions of low-level solid radioactive material (LLS) and of low specific activity material (LSA) are withdrawn, and the definition of low specific activity material in the present rule is retained with some minor changes to make it

consistent with the new  $A_1/A_2$  system for defining Type A quantities of radioactive material. The proposed exemption from NRC regulation for LSA and LLS materials has been withdrawn pending resolution of this issue. A separate NRC rulemaking action to upgrade the LSA standards will be undertaken in the near future. . . *United States Activities*

New guidelines have been issued by the Office of the Federal Register on the use of numbering systems for regulations, and on the use of appendices. These new guidelines, and others concerning the writing of regulations in "plain English," have resulted in large but nonsubstantive changes in the format of 10 CFR Part 71. Existing Appendices A, B, D, and E have all been incorporated as new sections in the body of the rule and large, complex sections have been divided for clarity.

Two recent NRC decisions have resulted in minor changes from the Transportation rules proposed in 1979. The definition of "radioactive material" has been deleted because it duplicated, in a less effective manner, the function of the long standing exemption in proposed § 71.8(a) (now § 71.10(a)) which avoids any regulatory requirements for radioactive material having a specific activity not greater than .002 microcuries per gram. Although this leaves NRC rules without a definition of radioactive material corresponding to those of DOT and IAEA, there is no substantive inconsistency because the exemption provisions are retained.

NRC has also decided to require reporting of package defects within 30 days of discovery to assist the staff in follow-on evaluations of approved package designs. Reporting of defects is already required by 10 CFR Part 21, "Reporting of Defects and Noncompliance," and is added to the proposed reporting requirement in § 71.61 (now § 71.95) for clarity and emphasis. The information to be reported has been moved from the 10 CFR Part 71 recordkeeping requirement of § 71.62 (now § 71.91) to the reporting

requirement in § 71.95.

### Other Rulemaking Actions Included

On November 2, 1979, the NRC published in the Federal Register (44 FR 83083) a final rule to require all shipments of radioactive material made by NRC specific licensees to be made in accordance with the regulations of DOT. The effect of the rule was to allow the NRC to inspect the activities of its licensees involved with shipment of radioactive materials against the requirements in DOT regulations. Licensees who violate the referenced DOT standards also violate NRC regulations. Those changes are incorporated in this revised rule.

On January 6, 1982, the NRC published in the Federal Register (47 FR 508) a final rule to require advance notification to the governor of any state prior to transport of certain types of nuclear waste, including spent fuel, to, through, or across the boundary of that state. That requirement has been repositioned in this revised rule for clarity, and is now codified as § 71.97 "Advance notification of shipment of nuclear waste." The associated definition of "nuclear waste" has been incorporated into § 71.97.

The preamble to the final rule imposing the advance notification requirement recognized that the term "large quantity," which establishes the level of radioactivity at which the advance notification is required, was being eliminated from the regulations. The original purpose of the term, as a designator of the quantities of radioactive materials which generate sufficient decay heat to warrant consideration of heat dissipation in the package design and approval, is antiquated, as all Type B packages are now evaluated for heat dissipation under both normal and accident conditions. In addition, the elimination of the transport group system for classifying radionuclides in favor of the  $A_1/A_2$  system has removed the basis on which the term "large quantity" was defined. This final rule retains the advance notification requirement with the same limits on reportable quantities. There have been some minor changes made to make the requirement consistent with the new  $A_1/A_2$  system for defining Type A quantities of radioactive material.

On November 13, 1981 the NRC published in the Federal Register (46 FR 55992) a proposed rule to restrict the air transport of plutonium. Under the proposed rule, plutonium could be transported by air only in a package specifically certified by NRC as air-crash resistant unless the plutonium is in a medical device for individual human use or is shipped in quantities or



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other agencies having jurisdiction over means of transport.

§ 71.5 has been revised for clarity to refer specifically to those revisions of DOT regulations which are imposed by reference. The list of provisions is not inclusive, however. A knowledge of all applicable DOT regulations is necessary.

### *Section 71.7 Exemption of Physicians (now § 71.9)*

Two comments related to the exemption of physicians in proposed § 71.7, and particularly to the idea that large quantities of radioactive material could be carried by physicians without any regulatory control. When this physician exemption was introduced into Part 71, the Notice of Proposed Rulemaking (36 FR 8521, April 8, 1971) explained that the exemption was "in line with the position taken several years ago by the Interstate Commerce Commission and now assumed by the Department of Transportation, that the DOT regulations do not apply to physicians transporting in their own vehicles radioactive material used for treatment or diagnosis." The physician exemption was added to the regulations concurrently with § 71.5 which imposed DOT regulations, by NRC (AEC at that time) authority, on persons not otherwise subject to them. The physician exemption served to avoid having NRC impose DOT regulations on physicians when DOT chose not to impose them by its own authority. The changes to the physician exemption by this rule clarify that physicians are exempt only from § 71.5, and therefore from NRC imposition of DOT requirements, but are subject to requirements of Part 71 if they transport fissile material or Type B quantities of other radioactive material. Physicians who are exempt from § 71.5 under this provision must possess an NRC license under Part 35 of this chapter.

### *Section 71.6 Exemption for low level materials (now § 71.10)*

The exemption for low specific activity material and low level solids has been removed from this section because NRC plans to retain control over Type B quantities of such material until questions regarding the adequacy of the standards have been resolved.

### *Section 71.9 Exemption for fissile material (now § 71.53)*

For clarity, the provisions describing the types of fissile material that are exempt from fissile packaging standards now precede the general requirements for all fissile material packages. In addition, a new entry dealing with irradiated natural or depleted uranium has been added.

### *Section 71.11 General license for shipment of fissile material*

The extensive provisions of § 71.11 have been divided, for clarity, into four new sections codified as §§ 71.18-71.24. The substance of the four new sections corresponds to the substance of paragraphs (a), (b), (c), and (e) of § 71.11 of the proposed rule. The substance of proposed § 71.11(d) was to provide system flexibility once an NRC fissile package approval has been issued. This type of provision is more appropriately placed in DOT regulations, and has been placed there.

### *Section 71.12 General license for shipment in approved packages (new §§ 71.12-71.16)*

The extensive provisions of § 71.12 have been divided, for clarity, into three new sections codified as §§ 71.12, 71.14, and 71.16. The substance of the three new sections corresponds to the substance of paragraphs (b), (a) and (c), respectively, of § 71.12 of the proposed rule.

One commenter noted that this section fails to grant a license to transport Type A packages and packages containing low specific activity material, and that DOT regulations also do not grant that type of license. The requirement for a license to transport radioactive material is not pervasive throughout the regulatory system. The requirement for a general or specific license is imposed by § 71.3 of NRC regulations, but that section specifically excludes from the licensing requirement persons who are "exempted in this part." Those exempted are identified in § 71.8 (now § 71.10) as including licensees who ship Type A packages. DOT regulations do not impose a licensing requirement, so no license is required by either Federal regulation for shipments exempt under § 71.8 (now § 71.10).

Another question asked concerning § 71.12 is as follows: "In the event a licensee who is not the owner of a package procures a package for another licensee to make a shipment, which licensee(s) must register as users of the package and have copies of the Certificates of Compliance and all referenced documents?" As provided in § 71.2 "Scope" (now § 71.0), the regulations in Part 71 apply " \* \* \* if the licensee delivers such materials to a carrier for transport or transports such material outside the confines of his facility, plant or other authorized place of use." The requirements of Part 71, and thus of § 71.12, apply to a licensee who ships or transports licensed radioactive material. A licensee who procures a package but does not use it to ship or transport licensed material is not subject to the regulations of Part 71.

### *§ 71.31 Demonstration of compliance (now § 71.41)*

In response to public comments this section has been revised to clarify the intent that actual testing is not always required. The demonstration of compliance might, for example, include a combination of full-scale testing, scale model or mockup testing, calculation, and reference to other suitably documented tests. Compliance with thermal test requirements, for example, is often demonstrated by calculation or a combination of calculation and test. As another example, some packages such as those made of metal, would obviously suffer no ill effects from the water spray test, so that appropriate statements about the design might then suffice.

### *Section 71.32 Standards for all packages (now § 71.63-71.67)*

Par. (h)—The appropriateness of the reference to "NRC approved test procedures" was questioned, because no reasonable procedures have yet been published by NRC. There are some acceptable leak testing procedures in Regulatory Guide 7.4, "Leakage Tests on Packages for Shipment of Radioactive Materials," which refers to the standards published in the American National Standards Institute Publication N14.5. However, the reference to "NRC approved test procedures" was primarily to procedures the NRC has been or will be approving with quality assurance plans submitted for package approval (as required under proposed § 71.24), or with quality assurance plans submitted for approval under proposed § 71.12 to qualify for the general license provisions. The phrase "NRC approved test procedure" has been deleted from the final rule as unnecessary.

*Section 71.36 Special requirements for plutonium shipments (now § 71.63)* An objection was received on the continuance of this special requirement which is not contained in IAEA regulations. The requirement was justified when imposed in 1974: the Commission considers that the need for this requirement still exists.

A comment suggests changes to the scope of this section to include other radionuclides of similar radiotoxicity such as californium-249, californium-252, and protactinium-231, and to exclude plutonium-241 because of its relatively low radiotoxicity. While this suggestion may have merit, it will be considered in a separate rule making action since it is beyond the scope of this particular action.

A question was asked whether PuO<sub>2</sub> would be considered as a solid for the

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purpose of this requirement. PuO<sub>2</sub> in a powder form or pressed into a pellet would be considered a solid for purposes of this requirement; PuO<sub>2</sub> suspended in a liquid would not.

Par. (b)—It was suggested that a specific exemption be included for solid waste which contains plutonium from the requirements for solid form and double containment, or alternatively that specific criteria be included to qualify for that exemption. The establishment of detailed criteria would require further experimental work and analysis. However, the general consideration that the plutonium must be in "nonrespirable" form is discussed in the Statement of Considerations accompanying the rulemaking action requiring solid form and double containment as published in the Federal Register on June 17, 1974 (39 FR 20960). Possible exemptions must, at present, be considered on a case-by-case basis, and undoubtedly some solid waste forms would not qualify as being sufficiently nonrespirable.

### *Section 71.37 Previously approved packages (now § 71.13)*

It was suggested that an application for renewal of an existing certificate of compliance should be evaluated under the same criteria as the original application. The purpose of proposed § 71.37 was to allow the continued use of existing packages without regard to the relatively minor changes to the package standards effected by this rule. The purpose was not to prolong the existence of the old standards, not even for purposes of certificate renewal or minor design changes. Existing package approvals for the use of existing hardware will be renewed without regard to the change in package standards, although other factors, such as package experience or inspection history, may result in denial of an application for renewal of a Certificate of Compliance.

The provisions of proposed § 71.37 have been incorporated by reference into the new § 71.12 "General license: NRC approved package." The general license of § 71.12 continues to apply to previously approved packages if fabrication of the packages is completed by August 31, 1986. After August 31, 1986, previously approved packages cannot be used for international transport unless they have been reapproved under the new standards and assigned a B(U) or B(M) designation, or shipped under special arrangement approved by the DOT. Paragraph 71.31(b) has been added to clarify that only limited changes to packaging or contents will be approved for previously approved packages without a demonstration that the new package standards are satisfied.

### *Section 71.52 Assumptions as to unknown properties (now § 71.83)*

A suggestion was made that "this section should be a part of § 71.35 since it does not address a transport operation, but deals with package evaluation." On the contrary, proposed § 71.52 (now § 71.83) is intended to assure that during the preparation of a package for shipment, a conservative approach is taken with respect to any pertinent property of fissile material to be transported when the property is not positively known. For this purpose, the Commission judges that the "Operating Controls and Procedures" Subpart to Part 71 is the proper location for the requirement. The design, evaluation, and Certificate of Compliance may cover a range of properties and quantities. For a particular shipment, however, some property or quantity may not be accurately known; in that case the most adverse credible assumption must be made for assessment of compliance.

### *Section 71.53 Preliminary determinations (now § 71.85)*

Par. (b)—Several commenters objected to the word "leak-tightness" as an acceptance standard for this overpressure test, on the grounds that it differs from the parallel IAEA requirement that imposes only a structural integrity acceptance criterion. A pressure test at some pressure higher than design pressure has been used, for example, in ASME Code practice, as a test for structural integrity but not for leak-tightness. The Commission considers that in the case of radioactive material packages, integrity of the containment (including closures, valves, and other possible routes of escape) should be demonstrated for each fabricated package before first use. Required tests for leak-tightness are presently related to the package design and are required as a condition of the package design approval.

Clarification of this requirement with respect to pressure relief devices was requested. Although a pressure relief device may need to be made inoperative to reach the test pressure of proposed § 71.53(b) (now § 71.85(b)), the device may normally be set below that test pressure for shipment, provided the criteria of Subparts E and F are satisfied.

### *Section 71.54 Routine Determinations (now § 71.87)*

Par. (b)—It was suggested that external radiation level limits (as well as other provisions) be excluded from NRC regulations in deference to the same provisions in DOT regulations. The Commission's policy in this matter is that all Type B and fissile material package requirements are to be included

in NRC regulations. External radiation level and temperature restrictions have been transferred to the "Package Standards" Subpart as design review requirements.

As suggested, the wording of the external radiation level limits has been made nearly identical to that of the DOT regulation. The limit at 2 meters from the surface also conforms to that of IAEA in that it does not apply to space above or below the vehicle. The 2-meter limit is for the purpose of controlling general public exposure for which there is little control needed above and below the vehicle. This is in contrast to the surface limits for control of exposure to persons working in and around the vehicle where the limits are applied to the upper and lower surfaces in addition to the vertical surfaces.

One commenter suggested that the external temperature limits be applied only to B(U) packages (as in IAEA regulations) but not to B(M) packages. It is the Commission's view that the higher temperature limit stated (82°C) would be applicable only to an exclusive use shipment where the carrier's handling procedures and the stowing of other cargo can be controlled by the shipper to avoid problems resulting from the higher surface temperature. All packages placed in normal transport must adhere to the lower temperature.

Par. (d)—As noted in the comments, there were no limits proposed on package coolant contamination. The Commission has adopted the IAEA rationale that contaminated coolant is part of the package contents, and must either be restricted to very low levels or retained in the package under the hypothetical accident conditions.

The level of non-fixed radioactive contamination on external surfaces of packages was limited in the proposed rule by values in Table VI. However, it was not sufficiently clear that when the wiping method is used, the limit of the radioactive contamination collected by the wiping material is not to exceed 10% of the values specified in the Table. Since the wiping method is used almost exclusively for determining non-fixed contamination levels, it is simpler to specify directly in the Table the limits on radioactive contamination as determined by the wiping method. Therefore, the levels in the Table (now Table V) are reduced by a factor of ten and these levels are specified as the limits for radioactive contamination as determined by the wiping method. Other methods of assessment of equal or greater detection efficiency may be used. For these methods, limits on radioactive contamination on the external surfaces of packages are specified. This change clarifies the meaning of the paragraph but does not



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change any regulatory requirement.

A commenter asked who must perform the preliminary and routine determinations and keep records where the shipper (licensee) of a package is not the owner (also a licensee) of the package. Ownership of a package is not important in satisfying Part 71 requirements. The scope of the rule applies the requirements to a person who is already licensed under any other part of 10 CFR Chapter I, but only if that licensee delivers licensed materials to a carrier for transport or if the licensee transports licensed material. A person who merely owns a package is not subject to the requirements of Part 71. On the other hand, a user of the package would be subject to the Part 71 requirements for preliminary and routine determinations and record keeping requirements, even though the user may not own the package. The user of the package always has the regulatory responsibility for preliminary and routine determinations. However, the user can contract with some other person, perhaps the owner, to satisfy those requirements for the user, although the user's records must demonstrate that the requirements have been satisfied.

It was noted that the choice of materials for packaging is dependent upon the low temperature initial condition for the normal transportation tests with respect to brittle fracture. The same commenter requested explicitly stated criteria on materials of construction to eliminate the present degree of subjective judgment. With this rule change, the Commission believes that the performance criteria for materials of construction that relate to brittle fracture are reasonably clear with a combination of temperature and drop tests, puncture, and vibration mechanical tests. Design guidance for brittle fracture is being developed within NRC and will be contained in a future regulatory guide.

### *Appendix A—Normal Conditions of Transport (now § 71.71)*

**Heat**—As discussed in the Notice of Proposed Rulemaking, the proposed ambient air temperature of 54° C (130° F), to which the effects of solar radiation must be added as an extreme condition of normal transport, differs from the IAEA figure of 38° C (100° F) to which the effects of solar radiation must be added. These final requirements of Part 71 have been modified to adopt the IAEA standard of 38° C plus specified solar radiation. This decision takes into account that Type B packages do not respond quickly to temperature changes, so a long-term average temperature test is more appropriate than a test which includes temperature extremes.

**Cold**—A commenter argued that the IAEA regulations are being misinterpreted when the NRC applies a temperature of -40° C as a normal transport temperature extreme. IAEA regulations state that "-40° C and 70° C shall be considered as satisfactory limits to be used in the selection of the materials." The Commission has chosen to use the lower temperature extreme as an ambient temperature not to be considered in combination with any impact. As such the lower temperature extreme provides protection against damage from differential thermal expansion and other static types of damage. Protection against dynamic types of damage is provided by the -29° C temperature, specified as an initial condition for the tests, in combination with mechanical impacts characteristic of rough handling in normal transport.

### *Appendix C—Determination of A<sub>1</sub> and A<sub>2</sub> (now Appendix A)*

Commenters pointed out that the new, lower A<sub>1</sub> value for sealed sources (special form) of americium and plutonium used in neutron sources and in nuclear-powered heart pacemakers involves significant costs without any apparent benefits. For the uses in question, the present 20 curie limit for Type A packages satisfies the international standard of not exceeding a dose rate level of 1000 millirem per hour at 3 meters from the source if all radiation shielding were lost. The proposed reduction in Type A package limits comes from an additional, arbitrary IAEA limit of a factor of 1000 on the difference in allowed radioactive contents between special form and non-special form sources. Because of the high radiotoxicity of most plutonium and americium isotopes, which severely restrict the A<sub>2</sub> (non-special form) values, the A<sub>1</sub> (special form) values in IAEA regulations are reduced to 3 curies for plutonium-238, 2 curies for plutonium-239, and 8 curies for americium-241. Because of the economic impact for neutron sources (oil well-logging industry) and heart pacemakers (health industry), the reduced limits proposed have been reevaluated, with the conclusion that the criteria are sufficiently conservative without the arbitrary limit to warrant retaining the 20-curie limits for domestic shipment in these cases. An exception has thus been introduced into § 71.10, "Exemption for low-level materials," retaining the 20-curie limit for domestic transport of americium and plutonium in special form.

A commenter questioned the A<sub>1</sub> values in Table A-1 for the radionuclides cesium-137 and strontium-90 as the values are related to those which would be obtained under the

Appendix instructions. In each case, the radionuclides are part of a decay chain, and the commenter, in calculating A<sub>1</sub> values, has ignored the radiation emitted by the daughter radionuclides of the decay chain. When the radiation emitted by the daughter radionuclides is considered, there is no discrepancy. The instructions in Appendix A, Section II, "mixture of radionuclides, including radioactive decay chains," have been modified to clarify this matter.

### *Comparison With Current Regulations*

Set forth below is a cross-index of sections contained in this final revision of Part 71, the previous effective regulation, and IAEA Safety Series No. 6, "Regulations for the Safe Transport of Radioactive Materials—1973 Revised Edition (As Amended)," dated 1979.



The Commission has determined that neither the Council on Environmental Quality guidelines, 40 CFR Part 1500, nor the NRC regulations in 10 CFR Part 51, "Licensing and Regulatory Policy and Procedures for Environmental Protection," requires the NRC to prepare an environmental impact statement for this revision of 10 CFR Part 51. Concurrently with the publication of this notice of rulemaking, the Commission is making available in its Public Document

Washington, DC, an "Environmental Impact Appraisal of Changes to Radioactive Material Transport Regulations," to support the negative Declaration required by 10 CFR Part 51. The information collection requirements in this final rule were not reviewed by the Office of Management and Budget at the proposed rule stage because the proposed rule was published prior to April 1, 1981, when

The Paperwork Reduction Act became effective. Therefore, the Nuclear Regulatory Commission is submitting the final rule to the Office of Management and Budget for any review appropriate under the Act (44 U.S.C. 3501 et seq.). The effective date for the information collection requirements in this rule provides the 60 days required for OMB review.

**List of Subjects in 10 CFR Part 71**  
 Hazardous materials—transportation.  
 Nuclear materials, Packaging and containers, Penalty, Reporting and

Administrative Requirements  
 : App A  
 : App B  
 : App C  
 : App D  
 : App E

Reference to the provisions of Department of Transportation regulations in 49 CFR Part 175.

Section	71.101	71.102	71.103	71.104	71.105	71.106	71.107	71.108	71.109	71.110	71.111	71.112	71.113	71.114	71.115	71.116	71.117	71.118	71.119	71.120	71.121	71.122	71.123	71.124	71.125	71.126	71.127	71.128	71.129	71.130	71.131	71.132	71.133	71.134	71.135	71.136	71.137	71.138	71.139	71.140	71.141	71.142	71.143	71.144	71.145	71.146	71.147	71.148	71.149	71.150	71.151	71.152	71.153	71.154	71.155	71.156	71.157	71.158	71.159	71.160	71.161	71.162	71.163	71.164	71.165	71.166	71.167	71.168	71.169	71.170	71.171	71.172	71.173	71.174	71.175	71.176	71.177	71.178	71.179	71.180	71.181	71.182	71.183	71.184	71.185	71.186	71.187	71.188	71.189	71.190	71.191	71.192	71.193	71.194	71.195	71.196	71.197	71.198	71.199	71.200
Purpose and scope	71.1	71.2	71.3	71.4	71.5	71.6	71.7	71.8	71.9	71.10	71.11	71.12	71.13	71.14	71.15	71.16	71.17	71.18	71.19	71.20	71.21	71.22	71.23	71.24	71.25	71.26	71.27	71.28	71.29	71.30	71.31	71.32	71.33	71.34	71.35	71.36	71.37	71.38	71.39	71.40	71.41	71.42	71.43	71.44	71.45	71.46	71.47	71.48	71.49	71.50	71.51	71.52	71.53	71.54	71.55	71.56	71.57	71.58	71.59	71.60	71.61	71.62	71.63	71.64	71.65	71.66	71.67	71.68	71.69	71.70	71.71	71.72	71.73	71.74	71.75	71.76	71.77	71.78	71.79	71.80	71.81	71.82	71.83	71.84	71.85	71.86	71.87	71.88	71.89	71.90	71.91	71.92	71.93	71.94	71.95	71.96	71.97	71.98	71.99	71.200

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CROSS INDEX

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### recordkeeping requirements.

Under the authority of the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended, and 5 U.S.C. 552 and 563, the following revision in its entirety of 10 CFR Part 71 is published as a document subject to codification.

notice contained a number of typographical errors which are corrected below. In addition, Table A-1 is reprinted in a larger format for reader convenience.

**FOR FURTHER INFORMATION CONTACT:** Donald R. Hopkins, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555. Telephone: 301-443-7876.

**SUPPLEMENTARY INFORMATION:** Corrections are made to the following pages:

1. On page 35601, column three, in the second complete paragraph, line 15, "beta-emitting" is corrected to read "beta-emitting".
2. On page 35602, column one, the fourth item in the third column of the table under the sentence which begins, "The radionuclides which are affected in Case 1 are:" "Te-127M" is corrected to read "Te-127m".
3. On page 35602, column one, the 11th item in the first column of the table under the sentence which begins, "The radionuclides which are affected in Case 2 are:" "Cu67" is corrected to read "Cu-67".
4. On page 35603 in column two, just above the center heading "Public Comments and Detailed Considerations" insert this paragraph:  
On October 1, 1976, Diagnostic Isotopes Incorporated petitioned the Commission to include the radionuclide lead-201 in Appendix C of 10 CFR Part 71, as a Transport Group IV radionuclide. Lead-201 decays in a short time to thallium-201 which is useful in clinical nuclear medicine. This final revision of 10 CFR Part 71 includes lead-201 in the table of radionuclides with a Type A quantity of 20 curies, thus granting the petition.
5. On page 35604, column one, line

three, "radioactive" is corrected to read "radioactive".

6. On page 35604, column three, in line five, "§ 71.0" is corrected to read "§ 71.0".

7. On page 35606, column one, in the first complete paragraph, line 19, "radioactive" is corrected to read "radioactive".

8. On page 35606, column three, in the first complete paragraph, line four, delete the "=" which precedes the number 90.

### PART 71—(CORRECTED)

9. On page 35608, column one, Subpart H—Quality Assurance, eighth entry which reads "71.115 Control of purchased material, equipment, and services," is corrected to read "71.115 Control of purchased material, equipment, and services."

#### § 71.0 [Corrected]

10. On page 35608, in § 71.0, line two, "Requirements" should be corrected to read "requirements"

#### § 71.4 [Corrected]

11. On page 35609, column two, in line eight of paragraph (5), "disintergations" is corrected to read "disintegrations"

#### § 71.12 [Corrected]

12. On page 35610, in § 71.12(e), a period is added to the end of the sentence.

#### § 71.16 [Corrected]

13. On page 35611, in § 71.16(c)(2), line 7, "license" is corrected to read "licensee"

#### § 71.18 [Corrected]

14. On page 35611, in § 71.18(c), delete the word "the" in line five, and the formula should be corrected to read as follows:

$$\text{Minimum Transport Index} = [0.40 + 0.6/y + z] \left( 1 - \frac{15}{x + y + z} \right)$$

#### § 71.20 [Corrected]

15. On page 35612, in § 71.20(b)(6), Table I should appear in paragraph (i) and Table II should appear in paragraph (ii).

#### § 71.24 [Corrected]

16. On page 35612, in § 71.24(b)(6), Table III should appear in paragraph (i) and Table IV should appear in paragraph (ii).

#### § 71.31 [Corrected]

17. On page 35613, in § 71.31(a)(3), the word "descriptions" is corrected to read "description".

18. On page 35613, column one, Table

III, the final item in the second column, headed "Permissible maximum grams of uranium-235 per consignment" is corrected to read "15,000".

#### § 71.33 [Corrected]

19. On page 35613, in § 71.33(a)(6), the final word is to read "coolant."

#### § 71.45 [Corrected]

20. On page 35614, in § 71.45(b)(2), line two, the word "tie-down" should not be hyphenated.

#### § 71.75 [Corrected]

21. On page 35617, in § 71.75(b), line three, "beding" is corrected to read "bending".

48 FR 38449

Published 8/24/83

### 10 CFR Part 71

#### Rule To Achieve Compatibility With the Transport Regulations of the International Atomic Energy Agency (IAEA)

**AGENCY:** Nuclear Regulatory Commission.

**ACTION:** Final rule; correction.

**SUMMARY:** In a Federal Register document published on August 5, 1983 (48 FR 35600), the U.S. Nuclear Regulatory Commission (NRC) revised its regulations for the transportation of radioactive material to make them compatible with those of the International Atomic Energy Agency (IAEA) and thus with those of most major nuclear nations of the world. This

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22. On page 35617, in § 71.75(d), line eight, "grater" is corrected to read "greater".

23. On page 35617, in § 71.75(d), line 11, the expression "(1.3 × 10<sup>-9</sup> atm cm<sup>3</sup>/s)" is corrected to read "(13.3 × 10<sup>-4</sup> atm cm<sup>3</sup>/s)".

24. On page 35617, in § 71.75(d), line 34, the expression "10<sup>-4</sup>" is corrected to read "10<sup>-6</sup>".

§ 71.77 [Corrected]

25. On page 35617, in § 71.77(c), line 12, the word "force" is corrected to read "face".

§ 71.87 [Corrected]

26. On page 35618, in § 71.87(i)(1), line 11, the word "and" is corrected to read "on".

§ 71.107 [Corrected]

27. On page 35621, in § 71.107(h), line two, the word "indentification" is corrected to read "identification".

Appendix A—[Corrected]

28. On page 35623, in Appendix A.I.(1), line five, the word "radionculides" is corrected to read "radionuclides".

29. On page 35623, in Appendix A.II.(5), line five, the word "radionculides" is corrected to read "radionuclides".

30. On page 35623, in column one of TABLE A-1, lines 8, 9, and 10, the footnote indicator "1" is corrected to read "".

31. On page 35625, in column one of TABLE A-1, lines 10, 11, 12, 13, 14, and 15, the footnote indicator "1" is corrected to read "".

32. On page 35626, in column one of Table A-1, lines 17, 18, 67, 68, 69, 70, 71, 72, 73, and 74, the footnote indicator "1" is corrected to read "". On line 45 the footnote indicator "2" is corrected to read "". On line 62 the footnote indicator "3" is corrected to read "".

33. On page 35625, in columns three and four, lines 71, 72, 74, and 76, the entry is corrected to read, "Unlimited".

34. On page 35626, columns three and four, lines 4, 42, 44, 58, 59, and 61 the entry is corrected to read "Unlimited".

35. On page 35626, column five, line four, "20 × 10<sup>-8</sup>" is corrected to read "2.0 × 10<sup>-8</sup>".

36. On page 35626, column five, line 44, "2.2 × 10<sup>-7</sup>" is corrected to read "2.2 × 10<sup>-1</sup>".

37. On page 35626, column five, on lines 59 and 61 the entry is corrected to read (SEE TABLE A-4).

38. On page 35626 line 60 is corrected to read:

U enriched < 20%	Unlimited	Unlimited	Five (see A-4)
20% or greater	100	0.1	Five (see A-4)

39. On page 35627, lines one, two, and four, footnote indicators "1", "2", "3", are corrected to read, "", "", "".

40. On page 35627, lines six, seven, eight, and nine, delete footnotes "4 Unlimited", "5 Unlimited 100", "6 Unlimited 0.1", "7 See Table A-4".

41. On page 35627, Table A-2, in the first column "> 2.0" is corrected to read "> 2.0".

42. On page 35627, "TABLE A-" is corrected to read "TABLE A-3".

43. On page 35627, in TABLE A-4, in the heading of first column, "wt" is deleted from first line and second line is corrected to read, "wt % <sup>235</sup>U present".

44. On page 35627, in TABLE A-4, column 2, line 13 "2.2 × 10<sup>-7</sup>" is corrected to read "2.2 × 10<sup>-1</sup>".

Dated at Bethesda, MD this 17th day of August, 1983.

For the Nuclear Regulatory Commission,  
Victor Stello, Jr.,  
Acting Executive Director for Operations.

48 FR 45381  
Published 10/5/83  
Effective 9/6/83

10 CFR Part 71

Rule To Achieve Competibility With  
the Transport Regulations of the  
International Atomic Energy Agency  
(IAEA)

AGENCY: Nuclear Regulatory  
Commission.

ACTION: Final rule; grant of petitions,  
correction, partial suspension of  
effective date.

SUMMARY: In a Federal Register  
document published on August 5, 1983  
(48 FR 35000), the U.S. Nuclear  
Regulatory Commission (NRC) revised  
its regulations for the transportation of  
radioactive material to make them  
compatible with those of the  
International Atomic Energy Agency

(IAEA) and thus with those of most  
major nuclear nations of the world. This  
notice and a subsequent correction  
notice that was published on August 24,  
1983 (48 FR 38449), contained a number  
of typographical errors, the remainder of  
which are corrected below. In addition,  
two petitions for rulemaking, PRM-70-8  
and PRM-71-3, are granted.

EFFECTIVE DATE: September 6, 1983. The  
information collection requirements in  
§§ 71.5, 71.7, 71.12(c)(3), 71.31, 71.33,  
71.35, 71.37, 71.39, 71.81(c), 71.85(c), 71.87  
(e) and (f), 71.89, 71.91, 71.93(c), 71.95,  
71.97, and 71.101-71.137 are suspended  
until the Office of Management and  
Budget (OMB) has completed its review  
of the information collection  
requirements. In order to minimize  
negative impacts through the period  
before this rule becomes effective,  
during which there are some  
inconsistencies between the presently  
effective regulations of NRC and the  
Department of Transportation (DOT),  
the NRC has adopted a policy of  
flexibility. In practical terms, in those  
situations where compliance with a new  
DOT requirement would be in conflict  
with a current 10 CFR Part 71  
requirement, NRC would in most cases  
accept compliance with the new DOT  
requirement. NRC would reserve  
judgment, however, to take enforcement  
action in an appropriate case.

FOR FURTHER INFORMATION CONTACT:  
Donald R. Hopkins, Office of Nuclear  
Regulatory Research, U.S. Nuclear  
Regulatory Commission, Washington,  
D.C. 20555, Telephone: 301-443-7876.

SUPPLEMENTARY INFORMATION:  
Corrections are made to the following  
pages:

1. On page 35603, as corrected by a  
document appearing at 48 FR 38449, in  
column two, just above the first  
paragraph which begins "On October 1,  
1976," insert this paragraph:

On July 18, 1977, Eberline Instrument  
Corporation petitioned the Commission  
(PRM-70-6) to approve the air transport  
of calibration or reference sources  
which contain not more than five  
microcuries of plutonium and which are  
generally licensed pursuant to 10 CFR  
70.19, "General license for calibration or  
reference sources." Air transportation of  
plutonium has been prohibited by NRC  
order since August 15, 1975, except  
when the plutonium is in a medical  
device for individual human use, or is in  
a package specifically certified by NRC  
as air-catch resistant. This final revision  
of 10 CFR Part 71 at § 71.88 allows the  
air transport of plutonium in quantities  
or concentrations small enough to  
present no significant hazard to the



PART 71 • STATEMENTS OF CONSIDERATION

public health and safety even if the plutonium were released in an air crash, thus granting the petition.

2. On page 35603, as corrected by a document appearing at 48 FR 38449, in column two, line five of the paragraph which begins "On October 1, 1976," is corrected to read as follows:

"71. as a Transport Group IV radionuclide (TRM-71-3). Lead-201 decays in a short".

3. On page 35607, the Paperwork Reduction Act Statement at the top of column three is corrected to read as follows:

**Paperwork Reduction Act Statement**

The information collection requirements in this final rule were not reviewed by the Office of Management and Budget (OMB) at the proposed rule stage because the proposed rule was published prior to April 1, 1981, when the Paperwork Reduction Act became effective. Therefore, the Nuclear Regulatory Commission is submitting this final rule to OMB for any review appropriate under the Act (44 U.S.C. 3501 et seq.). The effective date for the information collection requirements in

this rule provides the 60 days required for OMB review.

4. On page 35611, in § 71.18(c), the formula is corrected to read as follows:

Minimum Transport Index =

$$(0.40x + 0.67y + z)(1 - \frac{15}{x+y+z})$$

8. On page 35617, in § 71.75(d), line 11, the expression "(1.3 × 10<sup>-3</sup> atm cm<sup>-3</sup>)" is corrected to read "(1.3 × 10<sup>-4</sup> atm cm<sup>3</sup>/s)."

6. On page 35626, line 60 is corrected to read:

Symbol of radionuclide	Element and atomic number	A <sub>1</sub> (Ci)	A <sub>2</sub> (Ci)	Specific activity (Ci/g)
U (enriched)		Unlimited	Unlimited	(See table A-4)
< 20 percent		160	6.1	(See table A-4)
20 percent or greater				

7. On page 35627, Table A-2, in the first column ">2.0" is corrected to read ">2.0".

8. Sections 71.5, 71.7, 71.12(c)(3), 71.31, 71.33, 71.35, 71.37, 71.39, 71.81(c), 71.85(c), 71.87 (e) and (f), 71.89, 71.91, 71.93(c), 71.95, 71.97, and 71.101-71.137 are suspended.

Dated at Washington, D.C., this 27th day of September 1983.  
For the Nuclear Regulatory Commission.

Samuel J. Chilk,  
Secretary of the Commission.

48 FR 51903  
Published 11/15/83  
Effective 11/14/83

**10 CFR Part 71**

**Rule to Achieve Compatibility With the Transport Regulations of the International Atomic Energy Agency (IAEA)**

**AGENCY:** Nuclear Regulatory Commission.

**ACTION:** Final rule; correction; revocation of suspension.

**SUMMARY:** In a Federal Register document published on August 5, 1983 (48 FR 35600), the U.S. Nuclear Regulatory Commission (NRC) revised its regulations for the transportation of radioactive material to make them compatible with those of the International Atomic Energy Agency (IAEA) and thus with those of most major nuclear nations of the world. That notice and two subsequent correction notices were published on August 24, 1983 (48 FR 38449) and October 5, 1983

(48 FR 45381). The second correction notice also suspended the effective date of all sections in Part 71 that contained information collection requirements. This document corrects the remaining typographical errors and revokes the suspension.

**EFFECTIVE DATE:** November 14, 1983.  
**FOR FURTHER INFORMATION CONTACT:** Donald R. Hopkins, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555, Telephone 301-443-7878.

**SUPPLEMENTARY INFORMATION:** Corrections are made to the following pages:

1. On page 35607, the Paperwork Reduction Act Statement at the top of column three is revised to read as follows:

**Paperwork Reduction Act Statement**

This final rule amends information collection requirements that are subject to the Paperwork Reduction Act of 1980 (44 U.S.C. 3501 et seq.). These requirements were approved by the Office of Management and Budget on November 2, 1983 approval number 3150-0008.

2. On page 35611, in § 71.18(c), the formula is corrected to read as follows:

$$\text{Minimum Transport Index} = (0.40x + 0.67y + z) \left(1 - \frac{15}{x+y+z}\right)$$

3. On page 35617, in § 71.75(d), line 11, the expression "(1.3 × 10<sup>-3</sup> atm cm<sup>3</sup>/s)" is corrected to read "(1.3 × 10<sup>-4</sup> atm cm<sup>3</sup>/s)".

4. On page 35627, Table A-2, in the first column ">2.0" is corrected to read "≥2.0".

5. The suspension of §§ 71.5, 71.7, 71.12(c)(3), 71.31, 71.33, 71.35, 71.37, 71.39, 71.85(c), 71.87 (e) and (f), 71.89, 71.91, 71.93(c), 71.95, 71.97, 71.101-71.137 is revoked.

Dated at Washington, DC, this 7th day of November, 1983.

For the Nuclear Regulatory Commission.  
Samuel J. Chilk,  
Secretary of the Commission

## PART 71 • STATEMENTS OF CONSIDERATION

49 FR 19623  
Published 5/9/84  
Effective 5/9/84

*Information Collection Requirements;  
Display of OMB Control Numbers*

See Part 0 Statements of Consideration

52 FR 8225  
Published 3/17/87  
Effective 7/14/87

*Licenses and Radiation Safety  
Requirements for Well Logging*

See Part 39 Statements of Consideration

52 FR 31601  
Published 8/21/87  
Effective 8/18/87

*Statement of Organization and General  
Information*

See Part 1 Statements of Consideration

52 FR 49362  
Published 12/31/87  
Effective 2/1/88

*Completeness and Accuracy of  
Information*

See Part 2 Statements of Consideration

## Industrial Radiography Program

### Appendix B - Radiation Incidents

This appendix contains information on radiation incidents and other misc. information on Radiography as received in NRC Information Notices, NRC Bullitens or other sources.



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS  
WASHINGTON, D.C. 20555

SEPTEMBER 25, 1987

RECEIVED  
SEP 28 1987  
RELIABILITY & DESIGN  
ASSURANCE SECTION

NRC INFORMATION NOTICE NO. 87-45: RECENT SAFETY-RELATED VIOLATIONS OF NRC  
REQUIREMENTS BY INDUSTRIAL RADIOGRAPHY  
LICENSEES

Addressees:

All NRC licensees authorized to possess and use sealed sources for industrial radiography.

Purpose:

This notice is being issued to inform recipients about recent safety-related violations of NRC requirements. These occurred during industrial radiographic operations and could have been prevented by proper management control actions and attention to radiation safety procedures. It is suggested that recipients review this information, evaluate their procedures, and consider actions, if appropriate, to ensure that proper management control and proper attention to radiation safety procedures are being practiced by all members of their organization. However, suggestions contained in this information notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

As a followup to an allegation Region V received, the NRC regional offices and eight Agreement States conducted numerous in-depth inspections of a single radiography firm. These inspections were made from February 10 to June 2, 1987, at the firm's many job sites, scattered across the United States. These inspections identified numerous violations that had serious safety significance. In summary, these violations included:

- . Allowing individuals to act as radiographers and radiographers' assistants without their completion of the training requirements specified in 10 CFR 34.31(a)(3), 34.31(a)(4), 34.31(b)(3), and the licensee's in-house training program. In addition, training records required by 10 CFR 34.31(c) to be maintained for three years were missing or incomplete.

- . Personnel overexposures were not reported to the NRC, as required by 10 CFR 20.405. In addition, adequate evaluations were not performed of either the causes of the overexposure incidents or of the overexposure doses personnel actually received during these incidents.
- . Utilization logs were not completed, as required by 10 CFR 34.27.
- . Radiation surveys did not meet the requirements of 10 CFR 34.43 or 20.201.
- . High radiation areas were not maintained under the direct surveillance of radiographers or radiographers' assistants, as required by 10 CFR 34.41.
- . Radiographers and radiographers' assistants were not audited, as required by 10 CFR 34.11(d), or by specific license condition, or both.
- . Daily and quarterly inspection and maintenance operations were not performed on radiographic exposure devices, storage containers, or source changers used by the licensee, as required by 10 CFR 34.28.
- . Incompatible equipment was used during a source exchange.
- . Records of personnel exposure and survey results were not maintained, as required by 10 CFR 20.401(a) and (b), respectively.

Due to the serious nature of these violations, NRC personnel concluded that stronger management control was needed to administer the dispersed and numerous activities of this licensee, to ensure the health and safety of the public and licensee personnel. Therefore, an Order modifying this license was issued on June 17, 1987. The provisions of the Order are summarized below:

- . A responsible, qualified Radiation Safety Officer (RSO) must be appointed for each (continuing) job site or, in the case of temporary job sites, for the centralized facility (field office) controlling licensed activities at temporary job sites.
- . All licensed material must be placed in secure storage until the RSO is designated for the job site or field office.
- . All required documentation must be maintained by the job site RSO or field office RSO, with a copy sent to the corporate headquarters.
- . The RSOs shall have authority, in writing, to suspend any activity which is not in compliance with the license. The overall responsibility for implementing the radiation safety program rests with the corporate headquarters.

The licensee shall obtain the services of one or more independent consultant(s) to assess: employee qualifications; organizational structure; procedural implementation; records maintenance; and audit results.

The recommendations of the independent consultant(s) shall be submitted to the NRC at the same time as they are submitted to the licensee. Within 30 days after receipt of the reports, the licensee must submit an implementation plan to the NRC.

Discussion:

These violations illustrate a significant breakdown in the management oversight and control of the licensee's radiation safety program. This situation demonstrates the importance of:

1. Assuring that all radiographers and radiographers' assistants meet the training criteria specified in 10 CFR 34.31 and as outlined in Attachment 1.
2. Assuring that the number of trained radiographers and radiographers' assistants sent to each work location is sufficient to perform the radiographic operations, perform all required surveys, and maintain direct surveillance of all access points to high radiation areas. Work assignments are also outlined in Attachment 1.
3. Conducting onsite audits of each radiographer and radiographer's assistant, as required by 10 CFR 34.11(d) and specific license condition.
4. Assigning a qualified, experienced radiographer to be responsible for radiation safety at each field office and continuing job site. This individual would have the authority to suspend any activity not in compliance with NRC regulations or the license.
5. Requiring that a person responsible for radiation safety at each field office and continuing job site forwards records to the corporate headquarters for prompt review and follow-up, if warranted.
6. Properly reviewing, evaluating, and reporting all incidents which may have caused personnel exposures in excess of the limits stated in 10 CFR 20.101, 20.104, or 20.105.

It is suggested that copies of this notice be distributed to each field office and continuing job site and that all radiography personnel be reminded of their responsibilities to assure safe operations at each work location.



No specific actions or written response is required by this Information Notice. If you have questions about this matter, please contact the appropriate NRC regional office or this office.

*Alan L. Spolansky*  
Richard E. Cunningham, Director  
Division of Industrial and  
Medical Nuclear Safety  
Office of Nuclear Material Safety  
and Safeguards

Technical Contact: J. Bruce Carrico, NMSS  
(301) 427-4280

Attachments:

1. Assignments and Training of Radiographers and Radiographers' Assistants
2. List of Recently Issued NRC Information Notices

ASSIGNMENTS AND TRAINING OF RADIOGRAPHERS  
AND RADIOGRAPHERS' ASSISTANTS

CATEGORIES OF WORK THAT MUST BE DONE BY A RADIOGRAPHER OR BY A RADIOGRAPHER'S ASSISTANT UNDER A RADIOGRAPHER'S PERSONAL SUPERVISION (REF. 10 CFR 34.44)

- . Use of radiography camera, including positioning collimators; use of sealed sources and handling tools; and use of radiation survey instruments (ref. 10 CFR 34.44).
- . Performance of required surveys (ref. 10 CFR 34.43).
- . Maintenance of direct surveillance of all access points to high radiation areas created by radiographic operations (ref. 10 CFR 34.41).

REQUIRED TRAINING FOR RADIOGRAPHERS (REF. 10 CFR 34.31(a))

- . Instruction in radiation safety topics (ref. 10 CFR Part 34, Appendix A); NRC regulations in 10 CFR Parts 19, 20, and 34; NRC license under which the radiographer will work; the licensee's operating and emergency procedures; AND
- . Demonstrated competency in the use of the licensee's radiography and radiation survey equipment; AND
- . Successful completion of a written examination on radiation safety and regulatory matters; AND
- . Successful completion of a field (practical) examination.

REQUIRED TRAINING FOR RADIOGRAPHERS' ASSISTANTS (REF. 10 CFR 34.31(b))

- . Instruction in (and copies of) the licensee's operating and emergency procedures; AND
- . Demonstrated competency in the use, under the personal supervision of a radiographer, of the licensee's radiography and radiation survey equipment; AND
- . Successful completion of an oral or written test and of a field (practical) examination on the above subjects.

TRAINING RECORDS (REF. 10 CFR 34.31(c))

- . Keep records of above training including copies of written tests and dates of oral tests and field (practical) examinations.
- . Keep records for three years.

UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS  
WASHINGTON, DC 20555

October 5, 1987

NRC Information Notice No. 87-47: TRANSPORTATION OF RADIOGRAPHY DEVICES  
(Update of IE Information Notice No. 81-02,  
January 23, 1981)

Addressees:

All NRC licensees authorized to manufacture, distribute and/or operate radiographic exposure devices and/or source changers.

Purpose:

This notice is provided to remind licensees of the pertinent transportation requirements for radiography devices when used as transport "packages." The following explanations should help to clarify the application of operational licensing requirements versus transport requirements applicable to shippers and carriers, thereby prompting improved regulatory compliance with these requirements. Requirements for a license are attached.

It is suggested that licensees review this information for applicability to their operations involving transportation of radiography devices, and consider actions, if appropriate, to preclude violations of the transport regulatory requirements. However, suggestions contained in this notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

Inspections by NRC have identified frequent noncompliance with transportation regulations by radiography licensees. As of December 3, 1979, the NRC inspection program has included inspection/enforcement of U.S. Department of Transportation (DOT) regulatory requirements in 49 CFR 170-189 as direct NRC requirements (see 10 CFR 71.5).

The nature of radiography operations is unique in that radiography devices most frequently serve a dual function; that is, they serve as operational radiography cameras/source changers and as transportation packages. Historically, this has



caused some confusion for radiography users, particularly with respect to sorting out the transport regulatory requirements of DOT/NRC from the operational requirements of 10 CFR 34 and the specific license which has been issued to the user of radiography devices. Another source of confusion for the radiography operator is that he most frequently functions, with respect to the transportation regulations, in the dual role of both shipper and carrier.

Discussion:

Source Design -- Radiography sources contained within a device are always encapsulated radioactive material (Co-60 or Ir-192). They should meet the physical integrity requirements of "special form," as defined in 49 CFR 173.403(z) and 10 CFR 71.4. Radiography transporters are reminded that requirements in 49 CFR 173.476(a) call for each shipper of a special form source to maintain a file of supporting safety analysis or documentation containing the results of the testing performed on the source design to demonstrate that it meets the special form requirements. This does not mean that each shipper has to actually perform the tests, only that the shipper obtain and retain the documentation of the tests. As a practical matter, each radiographer should establish a file of such data for each source design that is used. It may be necessary, therefore, for the radiographer to request the required information from the source manufacturer/supplier.

Package Design -- Radiography sources in special form will constitute a Type B quantity of radioactive material, with Type B packaging required for transportation purposes, when the activity is in excess of a  $A_1$  curies ( $A_1Ci$ ).

Issuance of an NRC Certificate of Compliance is a necessary prerequisite to the use of a radiography device containing a special form source that exceeds  $A_1$  curies. For those radiography devices that exceed  $A_1$  activity, an NRC Certificate of Compliance (COC) must be issued, as required by 10 CFR 71.12 and 49 CFR 173.416(b). Such approved devices may be used by other than the original COC applicant, provided that such user registers with the NRC Office of Nuclear Material Safety and Safeguards (NMSS), has a copy of the applicable COC, and complies with its terms and conditions (see 10 CFR 71.12). A listing of radiography devices for which NRC has issued a COC is given in Table 1 (see Enclosure 2). Copies of COCs are included in the NRC/NMSS report, "Directory of Certificates of Compliance for Radioactive Materials Packages" (NUREG-0383), which is updated annually. (Devices which were manufactured to the now obsolete DOT Spec. 55 are no longer authorized for transportation unless enclosed in a DOT specification overpack. See specification overpacks below.)

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\* $A_1$  = maximum activity permitted in a Type A package when the material is in "special form." For Ir-192,  $A_1$  = 20 Curie; for Co-60,  $A_1$  = 7 Curie (defined in 49 CFR 173.403(a) and 10 CFR 71.4. There are tables of  $A_1/A_2$  values for radionuclides in 49 CFR 173.435 and in 10 CFR 71, Appendix A).

**CAUTION:** The fact that the use of a radiography device has been approved by NRC under a specific license provision pursuant to 10 CFR Part 34 as an operational device does not mean that NRC has approved it as a Type B transport package pursuant to 10 CFR Part 71.

For international shipments, shippers must additionally register with DOT as users of the DOT Certificate of Competent National Authority pursuant to 49 CFR 173.472. DOT further requires that this certificate be supplied to the foreign consignee and Competent National Authority of the destination country and other countries through which the package will be transported.

Specification Overpacks -- Pursuant to 49 CFR 173.416(f) or (g), DOT Spec. 55 packages may be used to transport quantities of activity exceeding  $A_1Ci$  of special form radioactive material provided that a Spec. 20 WC (49 CFR 178.194) or Spec. 21 WC (49 CFR 178.195) protective overpack is used. However, this authorization is restricted to the use of Spec. 55 packages constructed before April 31, 1975.

Type A Packages -- For radiography devices containing special form sources not exceeding  $A_1Ci$  of activity, the authorized packages are stated in 49 CFR 173.415. As a practical matter, the DOT Spec. 7A [49 CFR 173.415(a) and 178.350] is most frequently applicable. DOT regulations require that each shipper of a Spec. 7A package maintain on file written documentation showing that the construction methods, packaging, design, and material of construction comply with that specification [see 49 CFR 173.415(a)].

If the shipper of a Spec. 7A package is not the original designer or user of that package, it will be necessary for the shipper to obtain the test report data from the original designer/user or to perform and document the tests on his own [see 49 CFR 173.415(a) and 173.475].

Package Labeling -- During transportation each radiography device (package) must be properly labelled with the appropriate category of RADIOACTIVE label in accordance with 49 CFR 172.403. This requires affixing two labels on opposite sides of the package. The type of label is based on the radiation levels at the surface of the package and at 1 meter. The 1 meter dose rate determines the transport index (TI) that is indicated on the label. Additionally, the label must contain isotope and activity. The dose rates are limited to 200 mrem/hr at contact with any point on the external surface of the package and 10 mrem/hr at 1 meter from any point on the external surface of the package [10 CFR 71.47 and 173.441(a)].

A question frequently arises regarding the labeling of radiography devices when enclosed within an outer "convenience" box, enclosure, foot locker, etc., during transportation. The question is whether the radiation levels at the surface of such an outer enclosure may be used to establish the labeling requirements for

the overall "package." It is permissible to use such enclosures and to establish labeling on the basis of the radiation levels at the exterior of the outer enclosure. Assuming that the inner component (the device) is designed according to NRC/COC requirements, and is marked as such, the outer enclosure would also have to be marked with the words "Inside Package Complies with Prescribed Specification" [see 49 CFR 173.25(a)]. It must also be labeled, as required, based on the dose rates at the external surface of the package and at 1 meter from the outer enclosure.

**CAUTION:** The fact that a particular device has been approved in an NRC COC does not necessarily mean that, when fully loaded with its contents as authorized in a specific license, the dose rates will be within the regulatory limits. Each package must be surveyed to assure that proper labeling is applied and the appropriate  $\Gamma$  is present thereby.

Packages exceeding the limits of 49 CFR 173.441(a) may be transported in a closed, exclusive-use vehicle, such as a radiographer's van (but not an open pickup truck), provided that the following limits are not exceeded:

1,000 mrem/hr on the external surface of the package, 200 mrem/hr at any point on the external surface of the vehicle, and 10 mrem/hr at 2 meters from the lateral surfaces of the vehicle [49 CFR 173.441(b)].

This means that a radiographer may transport a package reading more than 200 mrem/hr at the surface, but not more than 1000 mrem/hr at the surface, in the radiographer's own exclusive-use vehicle [see 49 CFR 173.403(i)]. The radiographer may not deliver the same package to a carrier for transport unless the carrier's vehicle has been consigned for the radiographer's exclusive use.

Shipping Papers -- A shipping paper is required for each transfer of radioactive material from the confines of the licensee's plant, whether transported by the licensee or delivered to a carrier for transport. The shipping paper must include the information required by 49 CFR 172.202 and 172.203(d) for radioactive material, including the following:

1. The DOT proper shipping name. (For radiography devices, this will usually be "RADIOACTIVE MATERIAL, SPECIAL FORM N.O.S".) See 49 CFR 172.101. Also, the hazard identification number for special form is: "UN2974."

NOTE: For packages containing a special form source wherein the  $A_1$  limit equals the  $A_2$  limit for the specific nuclide, e.g.,  $\text{Co}^{60}$ , it is suggested that the DOT proper shipping name and hazard identification of "RADIOACTIVE MATERIAL, N.O.S" and "UN2982" be used. This will obviate the necessity to obtain the special form testing documentation. [See 49 CFR 173.476(c)]

2. The name of each radionuclide.
3. A description of the physical and chemical form of the material. For special form sources, this description is "SPECIAL FORM." In cases where  $A_1 = A_2$  and the special form proper shipping name is not used, a typical radionuclide name and description might be "Cobalt-60 as contained within a welded, hermetically sealed stainless steel capsule."



4. The activity contained in each package measured in curies.
5. The category of label applied to each package (RADIOACTIVE WHITE-I, RADIOACTIVE YELLOW-II, OR RADIOACTIVE YELLOW-III.)
6. The transport index assigned to each package bearing RADIOACTIVE YELLOW-II or RADIOACTIVE YELLOW-III labels.
7. The package certificate identification, if it is an NRC-certified package.
8. For shipments tendered to a common carrier, the appropriate signed shipper's certification, and, for shipments by aircraft, the additional statement of "cargo aircraft only."

NOTE: No industrial radiography shipments would be authorized for passenger-aircraft shipments, since the intended use of the radiography equipment is not for research or medical applications.

9. Instructions for maintenance of exclusive-use shipment controls, in the case of packages transported with the higher dose rates allowed by 49 CFR 173.441(b). [See 49 CFR 173.441(c).]

NOTE: The repetitive nature of radiography transportation lends itself to the preparation of a "permanent" type of shipping paper documentation that is specific to each particular source/device configuration. Such documentation could even take the form of laminated cards which are retained and accessible within the vehicle. [See 49 CFR 177.817(e).]

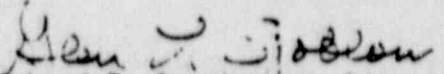
Vehicle Placarding -- The transport vehicle must be placarded by the licensee on the front, rear, and each side with the appropriate DOT placard (see 49 CFR Part 172.500-172.519, 172.556 and Appendices B and C) if any package bearing the RADIOACTIVE YELLOW-III label is to be carried in the vehicle. For a YELLOW-III labeled package tendered to a common motor carrier, the licensee must provide the required placards to the carrier at the time the packages are picked up, unless the carrier's vehicle is already placarded as required.

NOTE: DOT placard requirements should not be confused with radiography area posting requirements of 10 CFR 20.203 and 34.42.

Securing Cargo within Vehicle -- Radiography licensees who transport devices (packages) in their own vehicles must provide for adequate blocking, bracing, or tie-down of the package to prevent its shifting or movement during normal transport. Incidents have occurred where devices are dropped and lost from moving vehicles, often without the driver's awareness. These incidents are usually caused by the failure to properly secure the device, combined with a failure to secure the cargo door of the vehicle. Recent cases of this type have resulted in civil penalty for failure to comply with 49 CFR 177.842(d). (See NRC Information Notice No. 87-31, July 10, 1987.)

It is suggested that licensees review all movements of radiography devices away from their place of storage to ensure that they are (1) using appropriate packages; (2) properly controlling radiation levels on packages shipped; (3) providing proper shipping documents, and (4) following the applicable carrier requirements when transporting devices in their own vehicles.

No written response to this notice is required. If you require additional information regarding this matter, contact the appropriate NRC Regional Office or this office.

  
Richard E. Cunningham, Director  
Division of Industrial and Medical  
Nuclear Safety  
Office of Nuclear Material Safety  
and Safeguards

Technical Contacts: A. W. Grella, NMSS/SJOB  
(301) 427-4709

S. Baggett, NMSS/IMAB  
(301) 427-9005

Attachments:

1. Requirements for a License
2. List of Radiography Devices and Containers  
having NRC Certificates of Compliance
3. List of Recently Issued NRC Information Notices

## REQUIREMENTS FOR A LICENSE

The scope of 10 CFR Part 71, as defined in § 71.0(c) includes all specific licensees of the Commission if the licensee delivers radioactive material to a carrier for transport or transports the material outside the confines of his facility, plant, or other authorized place of use. This scope includes all radiographers licensed under 10 CFR Part 34, including those who conduct radiographic operations in the field, those who transport replacement sources, or who deliver replacement sources to a carrier for transport.

Section 71.3 "Requirement for License" in 10 CFR Part 71 prohibits any such transport or delivery to a carrier except as authorized in a general license or a specific license issued by the Commission, or as exempted in Part 71. Specific licenses issued under 10 CFR Part 34 are not intended to satisfy this requirement for a license prescribed by § 71.3. In most cases, the general licenses containing §§ 71.12, 71.14, and 71.16 of 10 CFR Part 71 are adequate to satisfy the requirement for license as applied to radiographers. Any specific license issued to satisfy this requirement would be issued pursuant to 10 CFR Part 71.

The three general licenses in 10 CFR Part 71, in §§ 71.12, 71.14, and 71.16, have conditions which apply to transportation of radiography devices or source exchangers. The user of the Part 71 general license (usually the shipper and frequently also the carrier of the radiographic exposure device) must register as a user of the general license with NRC and must have an approved quality assurance program which satisfies the provisions of Part 71, Subpart H (see § 71.101, "Quality Assurance Requirements").



Table 1 Radiographic devices and containers having NRC certificates of compliance

Manufacturer and Mod. No.	Use	Materials & Limit	Cert No.
<u>Magnaflex Corp.</u>			
MX-1C-100	Exposure Device	Ir-192 (100Ci)	9110
<u>Amersham Corp (Formerly Technical Operations)</u>			
650	Source Changer	Ir-192 (240Ci)	9032
660&660E	Exposure Devices	Ir-192 (120Ci)	9033
680&680E	Exposure Devices	Co-60 (110Ci)	9035
683	Exposure Device In an Overpack	Ir-192 (120Ci)	9053
684&684E	Exposure Devices	Co-60 (11Ci) or Ir-192 (240Ci)	9028
715	Overpack - For: 533, 616, 644, & 713 Exposure Devices	Ir-192 (120Ci For 533, 644 & 713), (240Ci for 616)	9039
741&741E	Exposure Devices	Co-60 (33Ci) or Ir-192 (240Ci)	9027
750	Source Changer	Ir-192 (240Ci)	9021
770	Source Changer	Co-60 (550Ci)	9148
771	Source Changer	Co-60 (110Ci)	9107
820	Source Changer	Ir-192 (1000Ci Total & 240Ci per Source)	9137
850	Source Changer	Ir-192 (240Ci)	9147
855	Source Changer	Ir-192 (1000Ci) Total (240Ci per source)	9165
858	Exposure Device	Co-60 (110Ci)	9154
864	Source Changer	Ir-192 (360Ci)	9166
865	Exposure Device	Ir-192 (240Ci)	9187

Table 1 (Continued)

Manufacturer and Mod. No.	Use	Materials & Limit	Cert No.
900	Exposure Device	Ir-192 (120Ci)	9141
910	Exposure Device	Ir-192 (30Ci)	9149
920	Exposure Device	Ir-192 (240Ci)	9143
<u>Amersham Corp (Formerly Automation Industries)</u>			
500-SU	Source Changer	Ir-192 (300)	9006
520	Exposure Device	Ir-192 (120Ci)	9007
500SU-OP	Overpack - For a 500-SU Source Changer	Ir-192 (300Ci)	9180
<u>Gamma Industries</u>			
6717-B	Overpack-For any Snug-Fitting Type A Devices	Ir-192 (200Ci)	6717
20&20A	Exposure Devices	Co-60 (20Ci)	9126
50&50A	Exposure Devices	Co-60 (50Ci)	9126
100&100A	Exposure Devices	Co-60 (100Ci)	9127
200&200A	Exposure Devices	Co-60 (200Ci)	9127
C-8	Source Changer - Skid mounted	Co-60 (200Ci)	9128
C-10	Source Changer	Ir-192 (240Ci)	9133
CenturyS, Century, SA, Century Universal S & Century Universal SA	Exposure Devices	Ir-192 (120Ci)	9135
<u>Industrial Nuclear Co.</u>			
Ir-50	Source Changer	Ir-192 (120Ci)	9156
Ir-100	Exposure Device [also may be in an optional overpack (OP-100)]	Ir-192 (120Ci)	9157

LIST OF RECENTLY ISSUED  
 INFORMATION NOTICES 1987

Information Notice No.	Subject	Date of Issuance	Issued to
87-46	Undetected Loss of Reactor Coolant	9/30/87	All PWR facilities holding on OL or CP.
87-45	Recent Safety-Related Violations of NRC Requirements by Industrial Radiography Licensees	9/25/87	All NRC licensees authorized to possess and use sealed sources for industrial radiography.
87-44	Thimble Tube Thinning in Westinghouse Reactors	9/16/87	All PWR facilities employing a <u>W</u> nuclear steam supply system holding an OL or CP.
87-43	Gaps in Neutron-Absorbing Material in High-Density Spent Fuel Storage Racks	9/8/87	All nuclear power reactor facilities holding an OL or CP.
87-42	Diesel Generator Fuse Contacts	9/4/87	All nuclear power reactor facilities holding an OL or CP.
87-41	Failures of Certain Brown Boveri Electric Circuit Breakers	8/31/87	All nuclear power reactor facilities holding an OL or CP.
87-40	Backseating Valves Routinely to Prevent Packing Leakage	8/31/87	All nuclear power reactor facilities holding an OL or CP.
87-39	Control of Hot Particle Contamination at Nuclear Power Plants	8/21/87	All nuclear power reactor facilities and spent fuel storage facilities holding an NRC license or CP.
87-38	Inadequate or Inadvertent Blocking of Valve Movement	8/17/87	All nuclear power reactor facilities holding an OL or CP.

OL = Operating License  
 CP = Construction Permit



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS  
WASHINGTON, D.C. 20555

March 28, 1988

NRC INFORMATION NOTICE NO. 88-10: MATERIALS LICENSEES: LACK OF MANAGEMENT CONTROLS OVER LICENSED PROGRAMS

Addressees:

All NRC licensees authorized to use byproduct material.

Purpose:

This information notice is provided to remind byproduct material licensees of their responsibilities for ensuring that radiation safety activities are performed in accordance with license conditions and other regulatory requirements. It is expected that licensees will review this information for applicability to their programs, distribute the notice to responsible radiation safety staff, and consider actions, if appropriate, to prevent problems from occurring at their facilities. However, suggestions contained in this Information Notice do not constitute new NRC requirements, and no written response is required.

Description of Circumstances:

During 1987, there were 56 cases in which the NRC took escalated enforcement action against byproduct material licensees. Thirty-one of these cases involved a civil penalty, 14 involved Orders to suspend the licenses or to show cause why the license should not be revoked, and one involved a Demand for Information. These escalated enforcement actions were taken because various serious violations of NRC license requirements occurred. These violations included employees being overexposed to radiation and members of the public being unnecessarily exposed to radiation. In addition, the financial consequences to the affected licensees have been significant because of the loss of income from the payment of civil penalties, the suspension or revocation of the license, and the costs of implementing corrective actions on an expedited basis.

An analysis of the causes of escalated enforcement cases identify three common reasons for serious violations. These were:

- Failure of management to read and understand the conditions of the license. Some licensees were unfamiliar with their license and the requirement to maintain a radiation safety program. NRC inspectors have found that some licensee managers have never read their license and have little understanding of license conditions and commitments.
- Failure to train the workforce properly regarding the requirements of the license, including required radiation safety procedures.

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Failure to monitor licensed operations, including failure to assure that licensee employees follow approved radiation safety procedures.

Discussion:

NRC holds licensee management, not the radiation safety staff or consultants, responsible for assuring the safe performance of licensed activities and adherence to NRC requirements.

Although there may be a radiation safety officer (RSO) assigned day-to-day radiation safety responsibilities, management retains responsibility to assure that radiation safety activities are performed in accordance with both internal procedures and NRC requirements. The amount of time necessary for management oversight will depend on the size and scope of the program. Management should support and monitor the RSO and safety staff to make sure they have adequate resources to do their jobs, are not devoting an inordinate amount of time to other duties, and adequately implement all radiation safety requirements.

The licensee's responsibility for control of its operations also extends to consultants and contractors. In certain circumstances, licensees may seek qualified assistance when the licensee staff does not possess the necessary experience, training, equipment, or personal dosimetry to perform particular activities. However, the responsibility for the safety of the operations and compliance with NRC requirements remains with the licensee.

NRC expects licensees' management to be aware of the conditions of their license to ensure that they understand their responsibilities under the license. This should include an examination of the details of their radiation safety program, to verify that the program complies with all requirements. As a result, licensees can avoid the serious consequences to their employees and the public and the significant financial costs that can result from failure to follow NRC requirements and from subsequent enforcement action by NRC.

No written response is required by this information notice. If you have any questions about this matter, please contact the appropriate NRC regional office or this office.

*Glen L. Sjoblom*  
Richard E. Cunningham, Director  
Division of Industrial and  
Medical Nuclear Safety  
Office of Nuclear Material Safety  
and Safeguards

Technical Contact: Jack R. Metzger, NMSS  
(301) 492-3424

Attachment: List of Recently Issued NRC Information Notices



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS  
WASHINGTON, D.C. 20555

RECEIVED  
MAY 02 1988  
REGISTRATION SECTION

April 25, 1988

INFORMATION NOTICE NO. 88-18: MALFUNCTION OF LOCKBOX ON RADIOGRAPHY DEVICE

Addressees:

All NRC licensees authorized to manufacture, distribute, and/or operate radiographic exposure devices.

Purpose:

This notice is to advise licensees about a radiography incident that could have resulted in a significant radiation exposure to workers or members of the public. It is expected that licensees review this information for applicability to their program, distribute the notice to responsible radiation safety staff, and consider actions, if appropriate, to prevent a similar situation from occurring. However, suggestions contained in this notice do not constitute new NRC requirements, and no written response is required.

Description of Circumstances:

The State of Louisiana has reported the failure of a lockbox on a Gamma Century SA radiography camera at an offshore Texas job site. The work involved radiographic examination of welds on an oil and gas production platform. After one exposure, when the radiographer cranked the source back into the camera, the fixed insert, spring, and movable insert, along with the source assembly, came partially out of the lockbox. This left a partially unshielded radiography source, which is hazardous and could cause a serious radiation injury in a matter of seconds. The radiographer was able to secure the area and return the insert and source to the device without any overexposure. The lockbox was secured with tape and the camera returned to the manufacturer.

When the device was examined by the manufacturer, two of the roll pins that hold the fixed insert in the lockbox were missing. The third roll pin had partially come out, thus allowing the insert and the source assembly to come out of the lockbox. Since two of the pins were missing, it is believed that the other pin could have worked free due to the pivot action that might occur when cranking the source assembly in and out of the device. No explanation is offered for why two of the roll pins were missing.

Item number 2 of the attached diagram (Figure 1) shows the location of the bottom roll pin. The two other roll pins, one on each side, were located at a 45° angle from the bottom pin. The missing pins may have been identified and replaced, if this item had been added to the daily equipment checks.

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Discussion:

Section 34.28 of 10 CFR Part 34 requires daily radiographic equipment checks for defects. Licensees should verify that they have appropriate programs in place to promptly identify equipment problems and correct them immediately. Also note that potential generic defects must be reported to the NRC in accordance with 10 CFR Part 21. Licensees may also wish to review their emergency procedures to assure that their radiographers will respond properly and safely in any event such as the one described involving an unshielded source.

No written response is required by this information notice. If you have any questions regarding this matter, please contact the person listed below or the appropriate NRC regional office.

*Richard E. Cunningham*

Richard E. Cunningham, Director  
Division of Industrial and  
Medical Nuclear Safety  
Office of Nuclear Material Safety  
and Safeguards

Technical Contacts: Steven L. Baggett, NMSS  
(301) 492-0613

R. J. Doda, Region IV  
(303) 236-2805

Attachments:

1. Diagram of Affected Lockbox
2. List of Recently Issued NRC Information Notices

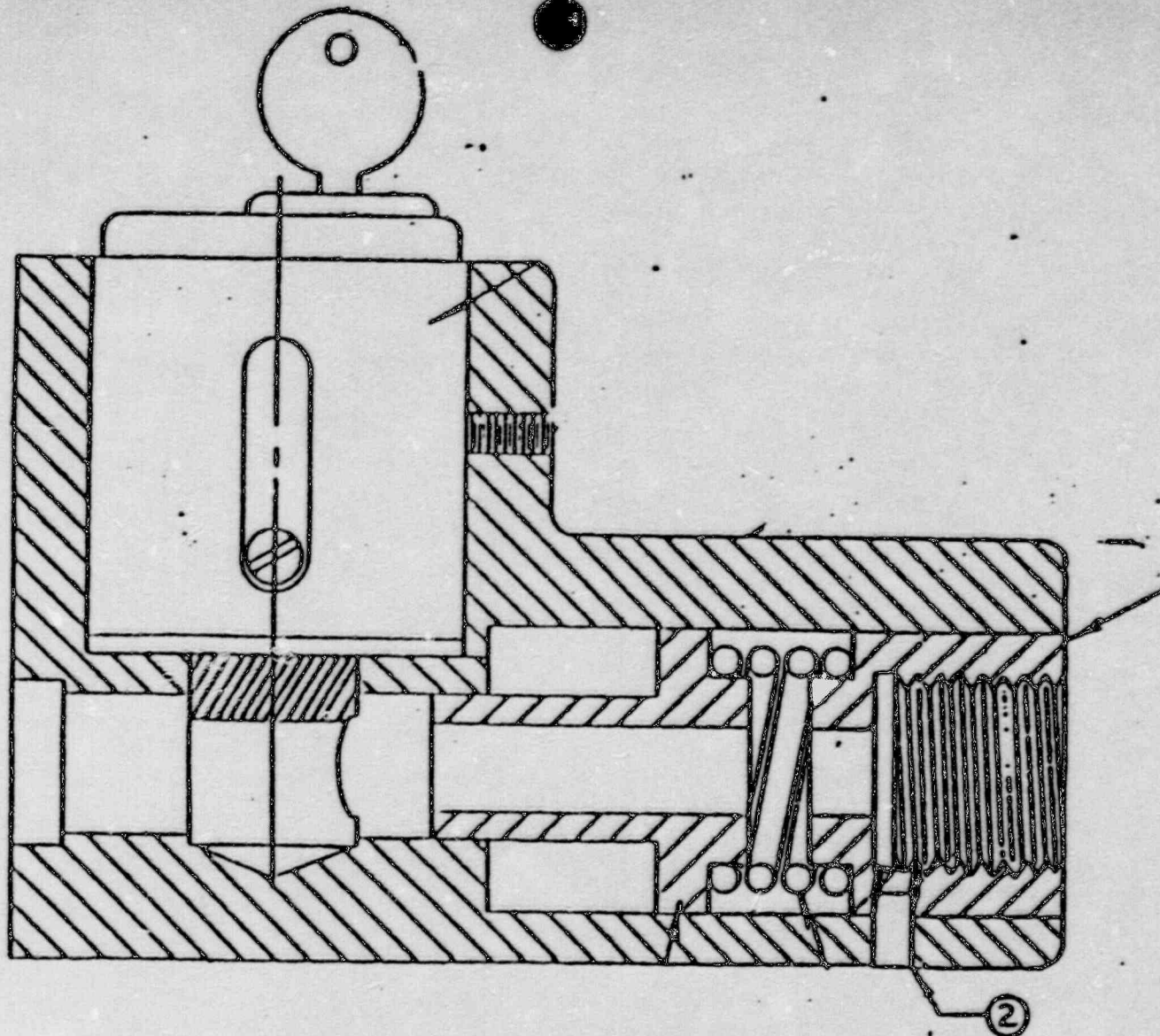


DIAGRAM OF AFFECTED LOCK BOX

Figure 1 Device, Showing Location of Bottom Roll Pin (No. 2)

Attachment 1  
 IN 88-18  
 APR 11 25, 1988  
 Page 1 of 1



RECEIVED

AUG 29 1986

RELIABILITY & DESIGN  
ASSURANCE SECTION

UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS  
WASHINGTON, D.C. 20555

August 22, 1986

NRC INFORMATION NOTICE No. 88-66: INDUSTRIAL RADIOGRAPHY INSPECTION AND  
ENFORCEMENT

Addressees:

All NRC industrial radiography licensees.

Purpose:

This information notice is being provided to emphasize the importance of compliance with NRC regulations in all aspects of industrial radiography. Recipients should review the information for applicability to their operations to ensure that all radiography personnel are fully trained and qualified and that they conduct operations in accordance with all applicable requirements. It is expected that licensees will review this notice, distribute it to responsible radiation staff, and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice do not constitute any new NRC requirements and no written response is required.

Description of Circumstances:

In August 1987, the NRC received allegations that Finlay Testing Laboratories, Inc. (FTL) of Aiea, Hawaii, was improperly transporting radiographic exposure devices containing radioactive sources on passenger-carrying aircraft. The NRC Region V office conducted an inspection, and the Office of Investigations (OI) investigated possible wrongdoing. These efforts revealed numerous instances where FTL personnel concealed radiographic exposure devices containing radioactive material, so as to transport them on passenger-carrying civilian and military flights. These actions, which violated NRC and U.S. Department of Transportation (DOT) regulations, apparently were taken to avoid the inconvenience of shipping devices containing radioactive material in the required manner.

Additional inspection findings revealed: (1) failures to survey devices to ensure that the sources were in the shielded position; (2) individuals acting as radiographers and radiographers' assistants without required Part 34 training; (3) violations of radiation safety program requirements for posting of radiation areas, surveillance of restricted areas, and locking of radiographic exposure devices; (4) use of partially discharged dosimeters; and (5) failures to maintain required records.

As a result of these findings, the NRC suspended FTL's license and subsequently issued an order to show cause why the license should not be revoked. In accordance with a settlement between the NRC and the licensee, the license was terminated and Gordon Finlay, owner of the licensee, agreed not to perform

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**Industrial Radiography Program**

**Appendix C - Material License**

This appendix shall contain a copy of Centerior Service Company's Material License upon receipt.

certain functions in radiographic operations until September 1990. Mr. Finlay also agreed to provide written notice to the NRC or any Agreement State before performing duties related to any licensed activities for a similar period. In addition, the matter has been referred to the U.S. Department of Justice for investigation of possible criminal wrongdoing.

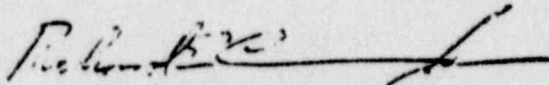
Discussion:

Licenses are responsible for ensuring the safe performance of licensed activities in accordance with NRC regulations and the terms of their licenses. In so doing, licenses should not only use trained individuals, provide adequate procedures and maintain accurate records, but should also exercise close supervision over their employees to ensure compliance with procedures and with NRC and any other applicable requirements. Licenses are also responsible for ensuring that an employee's prior experience, if any, has been satisfactory and complies with regulatory requirements.

Transportation of radiographic material, with its potential for impact on the public health and safety, is a matter of significant regulatory concern. This case highlights the need to ensure that material is packaged and shipped in approved ways to avoid potential exposure to the public.

Moreover, the NRC will not excuse licensee employee violations in radiography operations because management was unaware of the violations; because the employees were not trained to recognize applicable regulatory requirements; or because compliance with the applicable regulations would have been inconvenient. Similarly, violations of NRC requirements caused by inattention to detail are unacceptable and may result in substantial civil enforcement action. In addition, violations caused by intentional acts may subject wrongdoers to criminal prosecution. As evidenced by the cases described in Information Notice 86-54, "Criminal Prosecution of a former Radiation Safety Officer who willfully Directed an Unqualified Individual to Perform Radiography," and Information Notice 87-64, "Conviction for Falsification of Security Training Records," criminal sanctions may include a fine and/or imprisonment.

No written response is required by this information notice. If you have any questions about this matter, please call the technical contact listed below or the appropriate NRC Regional Office.

  
Richard E. Cunningham, Director  
Division of Industrial and  
Medical Nuclear Safety, NMSS

Technical Contact: M. Lamastra, NMSS  
(301) 492-3416

Attachment: List of Recently Issued NRC Information Notices

CONTROL NO. 87 45 8