

Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Commercial Radiopharmacy Licenses (NUREG SR1556, Vol. 13)

Publication Information

Final Report

Manuscript Completed: September 1999

Date Published: September 1999

Prepared by

J. Cameron, P. Henderson, D. Howe, J. Montgomery

**Division of Industrial and Medical Nuclear Safety
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001**

Abstract

As part of its redesign of the materials licensing process, NRC is consolidating and updating numerous guidance documents into a single comprehensive repository, as described in NUREG - 1539, "Methodology and Findings of the NRC's Materials Licensing Process Redesign," dated April 1996, and draft NUREG - 1541, "Process and Design for Consolidating and Updating Materials Licensing Guidance," dated April 1996. NUREG - 1556, Vol. 13, "Consolidated Guidance about Materials Licenses: Program-Specific Guidance About Commercial Radiopharmacy Licenses," dated September 1999, is the thirteenth program-specific guidance developed for the new process and is intended for use by applicants, licensees, and NRC staff, and will also be available to Agreement States. This document combines and supersedes the guidance found in "Draft Regulatory Guide DG-0006" (previously issued as FC 410-4), "Guide for the Preparation of Applications for Commercial Nuclear Pharmacy Licenses" (March 1997), and Standard Review Plan 85-14, "Standard Review Plan for Applications for Nuclear Pharmacy Licenses." This report takes a more risk-informed, performance-based approach to licensing commercial radiopharmacies and reduces the information (amount and level of detail) needed to support an application for these activities.

Figures

Figure 2.1 U.S. Map

Figure 8.1 Location of Use

Figure 8.2 Purpose Wheel

Figure 8.3 Typical Facility Diagram

Figure 8.5 Examples of Portable and Stationary Survey Instruments Used by Radiopharmacies.

Figure 8.6 Accountability

Figure 8.7 Annual Dose Limits for Occupationally Exposed Adults

Figure 8.8 Use of Appropriate Shielding

Figure 8.9 Types of Surveys

Figure 8.10 Personnel Surveys

Figure 8.11 Typical Surveys at Radiopharmacy

Figure 8.12 Returned Waste

Figure H.1 Typical Duties and Responsibilities of the RSO.

Figure K.1 Calculating Public Dose

Figure Q.1 Storage of Food and Drink

Foreword

The United States Nuclear Regulatory Commission (NRC) is using Business Process Redesign (BPR) techniques to redesign its materials licensing process. This effort is described in NUREG - 1539, "Methodology and Findings of the NRC's Materials Licensing Process Redesign," dated April 1996. A critical element of the new process is consolidating and updating numerous guidance documents into a NUREG series of reports. Below is a list of volumes currently included in the NUREG - 1556 series:

| Vol. No. | Volume Title | Status |
|-----------------|--|-------------------|
| 1 | Program-Specific Guidance About Portable Gauge Licenses | Final Report |
| 2 | Program-Specific Guidance About Industrial Radiography Licenses | Final Report |
| 3 | Applications for Sealed Source and Device Evaluation and Registration | Final Report |
| 4 | Program-Specific Guidance About Fixed Gauge Licenses | Final Report |
| 5 | Program-Specific Guidance About Self-Shielded Irradiator Licenses | Final Report |
| 6 | Program-Specific Guidance About 10 CFR Part 36 Irradiator Licenses | Final Report |
| 7 | Program-Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope | Draft for Comment |
| 8 | Program-Specific Guidance About Exempt Distribution Licenses | Final Report |
| 9 | Program-Specific Guidance About Medical Use Licenses | Draft for Comment |
| 10 | Program-Specific Guidance About Master Material Licenses | Draft for Comment |
| 11 | Program-Specific Guidance About Licenses of Broad Scope | Final Report |
| 12 | Program-Specific Guidance About Possession Licenses for Manufacturing and Distribution | Draft for Comment |
| 13 | Program-Specific Guidance About Commercial Radiopharmacy Licenses | Final Report |
| 14 | Program-Specific Guidance About Well Logging, Tracer, and Field Flood Study Licenses | Draft for Comment |

| Vol. No. | Volume Title | Status |
|-----------------|--|-------------------|
| 1 | Program-Specific Guidance About Portable Gauge Licenses | Final Report |
| 2 | Program-Specific Guidance About Industrial Radiography Licenses | Final Report |
| 3 | Applications for Sealed Source and Device Evaluation and Registration | Final Report |
| 4 | Program-Specific Guidance About Fixed Gauge Licenses | Final Report |
| 5 | Program-Specific Guidance About Self-Shielded Irradiator Licenses | Final Report |
| 6 | Program-Specific Guidance About 10 CFR Part 36 Irradiator Licenses | Final Report |
| 7 | Program-Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope | Draft for Comment |
| 8 | Program-Specific Guidance About Exempt Distribution Licenses | Final Report |
| 9 | Program-Specific Guidance About Medical Use Licenses | Draft for Comment |
| 10 | Program-Specific Guidance About Master Material Licenses | Draft for Comment |
| 15 | Guidance About Changes of Control and About Bankruptcy Involving Byproduct, Source, or Special Nuclear Material Licenses | Draft for Comment |
| 16 | Program-Specific Guidance About Licenses Authorizing Distribution To General Licensees | Draft for Comment |

The current document, NUREG - 1556, Vol. 13, "Consolidated Guidance about Materials Licenses: Program-Specific Guidance about Commercial Radiopharmacies," dated September

1999, is the thirteenth program-specific guidance developed for the new process. It is intended for use by applicants, licensees, NRC license reviewers, and other NRC personnel. It combines and supersedes the guidance for applicants and licensees previously found in “Draft Regulatory Guide DG-0006” (previously issued as FC 410-4) “Guide for the Preparation of Applications for Commercial Nuclear Pharmacy Licenses” (March 1997) and Draft Standard Review Plan 85-14, “Standard Review Plan for Applications for Nuclear Pharmacy Licenses.” In addition, this report also contains pertinent information found in Technical Assistance Requests and Information Notices, as listed in Appendix B.

This report takes a risk-informed, performance-based approach to licensing commercial radiopharmacies. It identifies the information needed from an applicant seeking to possess and use byproduct materials during the preparation and distribution of radioactive drugs and in the distribution of radiochemicals, sealed sources, and in-vitro test kits.

A team composed of NRC staff from headquarters and regional offices prepared this document, drawing on their collective experience in radiation safety in general and as specifically applied to commercial radiopharmacy. A representative of NRC’s Office of the General Counsel provided a legal perspective.

This report represents a step in the transition from the current paper-based process to the new electronic process. This document is available on the Internet at the following address:
<<http://www.nrc.gov/nrc/nuregs/sr1556/v13/index.html>>.

NUREG - 1556, Vol. 13, “Consolidated Guidance about Materials Licenses: Program-Specific Guidance about Commercial Radiopharmacy Licenses,” is not a substitute for NRC regulations, and compliance is not required. The approaches and methods described in this report are provided for information only. Methods and solutions different from those described in this report will be acceptable if they provide a basis for the staff to make the determination needed to issue or continue a license.

Donald A. Cool, Director
Division of Industrial and Medical Nuclear Safety
Office of Nuclear Material Safety and Safeguards

Acknowledgments

The writing team thanks the individuals listed below for assisting in the development and review of the report. All participants provided valuable insights, observations, and recommendations.

The team also thanks Kay Avery, Judy Boykin, Randy Glantz, Rolonda Jackson, D.W. Benedict Llewellyn, Steven W. Schawaroch, Agi Seaton, and Gina G. Thompson of Computer Sciences Corporation.

The Participants

Cameron, Jamnes L.

Camper, Larry W.

Cool, Donald A.

Henderson, Pamela J.

Hickey, John W.

Hosey, Charles M.

Howe, Donna-Beth

Howell, Linda L.

Kinneman, John D.

Merchant, Sally L.

Montgomery, James L.

Piccone, Josephine M.

Phillips, Monte P.

Roe, Mary Louise

Schwartz, Maria E.

Treby, Stuart A.

Abbreviations

| | |
|-------|---------------------------------------|
| ALARA | as low as is reasonably achievable |
| ALI | annual limit on intake |
| ANP | authorized nuclear pharmacist |
| ANSI | American National Standards Institute |
| AU | authorized user |
| bkg | background |
| BPR | business process redesign |
| Bq | becquerel |
| CDE | committed dose equivalent |
| CEDE | committed effective dose equivalent |

| | |
|---------------------|--|
| ALARA | as low as is reasonably achievable |
| CFR | Code of Federal Regulations |
| Ci | curie |
| cm | centimeter |
| cpm | counts per minute |
| DAC | derived air concentration |
| DDE | deep-dose equivalent |
| DFP | decommissioning funding plan |
| DIS | decay in storage |
| DOE | United States Department of Energy |
| DOT | United States Department of Transportation |
| dpm | disintegrations per minute |
| dpm/cm ² | disintegrations per minute per square centimeter |
| EDE | effective dose equivalent |
| FA | financial assurance |
| FDA | United States Food and Drug Administration |
| G-M | Geiger-Mueller |
| GPO | Government Printing Office |
| IN | Information Notice |
| IP | inspection procedure |
| mGy | milliGray |
| MDA | minimum detectable activity |
| MOU | Memorandum of Understanding |
| mR | milliroentgen |
| mrem | millirem |
| mrem/hr | millirem per hour |
| mSv | millisievert |
| mSv/hr | millisievert per hour |
| NCRP | National Council on Radiation Protection and Measurements |
| NIST | National Institute of Standards and Technology |
| NMSS | Office of Nuclear Materials Safety and Safeguards |
| NRC | Nuclear Regulatory Commission |

| | |
|-------|--|
| ALARA | as low as is reasonably achievable |
| NVLAP | National Voluntary Laboratory Accreditation Program |
| OMB | Office of Management and Budget |
| P&GD | Policy and Guidance Directive |
| QA | quality assurance |
| R | roentgen |
| RG | Regulatory Guide |
| RQ | reportable quantity |
| RSO | radiation safety officer |
| SDE | shallow-dose equivalent |
| SI | International System of Units (abbreviated SI from the French, Le Systeme Internationale d'Unites) |
| SSD | sealed source and device |
| std | standard |
| Sv | sievert |
| TAR | technical assistance request |
| TEDE | total effective dose equivalent |
| TI | transportation index |
| TLD | thermoluminescent dosimeters |
| USDA | United States Department of Agriculture |

1 Purpose of Report

This report provides guidance to an applicant applying for a commercial radiopharmacy license, as well as providing NRC with the appropriate criteria for evaluating such applications. Within this document, the terms “byproduct material,” “licensed material,” and “radioactive material,” are used interchangeably. In addition, the phrases or terms, “commercial radiopharmacy,” “radiopharmacy,” “nuclear pharmacy,” and “pharmacy” are used interchangeably.

Commercial radiopharmacy licenses are those licenses issued by the Commission, pursuant to 10 CFR Part 30 and 10 CFR 32.72, for the possession and use of radioactive materials for the manufacture, preparation, or transfer for commercial distribution of radioactive drugs containing byproduct material for medical use under Part 35. Within this document, preparation includes the making of radiopharmaceuticals from reagent kits (i.e., technetium-99m MAA (macroaggregated albumin)), and from raw materials (i.e., the compounding of radioiodine capsules for diagnostic and therapeutic medical use). Commercial radiopharmacies may also be authorized to transfer for commercial distribution *in vitro* test kits described in 10 CFR 31.11,

radiopharmaceuticals to licensees authorized to possess them for other than human medical use (i.e., veterinary medicine and research licensees), and radiochemicals to those licensees authorized to possess them, pursuant to 10 CFR Part 30. In addition, 10 CFR Part 30 authorizes radiopharmacies to redistribute (transfer) sealed sources for calibration and medical use initially distributed by a manufacturer licensed pursuant to 10 CFR 32.74.

Specific guidance for applicants requesting to manufacture and initially distribute molybdenum-99/technetium-99m generators, *in vitro* kits, radiochemicals and sealed sources is included in NUREG 1556, Vol 12, “Consolidated Guidance about Materials Licenses: Program-Specific Guidance about Manufacturing and Distribution Licenses,” and is not within the scope of this guidance for commercial radiopharmacies. These activities require specific NRC or Agreement State authorization and must be included on a specific license.

Furthermore, specific guidance for applicants requesting authorization to manufacture, distribute, and redistribute radioactive drugs to persons exempt from licensing (i.e., carbon-14 tagged urea) is included in NUREG - 1556, Vol. 8, “Consolidated Guidance about Materials Licenses: Program-Specific Guidance about Exempt Distribution Licenses,” and also is not within the scope of this guidance. These activities require specific NRC authorization and require the issuance of a separate license for exempt distribution.

This report identifies the information needed to complete NRC Form 313 (Appendix A), “Application for Material License,” for the use of byproduct materials in commercial radiopharmacies. The information collection requirements in 10 CFR Part 30 and NRC Form 313 have been approved under the Office of Management and Budget (OMB) Clearance Nos. 3150-0017 and 3150-0120, respectively.

The format within this document for each item of technical information is as follows:

- Regulations — references the regulations applicable to the item;
- Criteria — outlines the criteria used to judge the adequacy of the applicant’s response;
- Discussion — provides additional information on the topic sufficient to meet the needs of most readers; and
- Response from Applicant — provides suggested response(s), offers the option of an alternative reply, or indicates that no response is needed on that topic during the licensing process.

Notes and References are self-explanatory and may not be found for each item on NRC Form 313. Specific NRC references used in the development of this guidance document are included in Appendix B.

NRC Form 313 does not have sufficient space for applicants to provide full responses to Items 5 through 11; as indicated on the form, the answers to those items are to be provided on separate sheets of paper and submitted with the completed NRC Form 313. For the convenience of applicants and for streamlined handling of applications for commercial radiopharmacy licenses in the new materials licensing process, use Appendix C to provide supporting information, attach it to NRC Form 313, and submit it to NRC.

Appendix D is a checklist that NRC staff uses to review applications and that applicants may use to check for completeness. Appendix E is a sample commercial radiopharmacy license, containing the conditions most often found on these licenses, although not all licenses will have all conditions. Appendices F through S contain additional information on various radiation safety topics, including model procedures. Appendix T includes a table of NRC incident notification and reporting requirements applicable to commercial radiopharmacies.

In this document, dose or radiation dose means absorbed dose, dose equivalent, effective dose equivalent (EDE), committed dose equivalent (CDE), committed effective dose equivalent (CEDE), or total effective dose equivalent (TEDE). These terms are defined in 10 CFR Part 20. Rem, and its SI equivalent Sievert (1 rem = 0.01 Sievert (Sv)), are used to describe units of radiation exposure or dose. This is done because 10 CFR Part 20 sets dose limits in terms of rem, not rad or roentgen (R). When the radioactive material emits beta and gamma rays, for practical reasons, we assume that 1 R = 1 rad = 1 rem. For alpha emitting radioactive material, 1 rad is not equal to 1 rem. Determination of dose equivalent (rem) from absorbed dose (rad) from alpha particles requires the use of an appropriate quality factor (Q) value. Q values are used to convert absorbed dose (rad) to dose equivalent (rem). Q values for alpha particles are addressed in the Tables 1004(b)(1) and (2) in 10 CFR §20.1004.

2 Agreement States

Certain states, called Agreement States (see Figure 2.1), have entered into agreements with the NRC that give them the authority to license and inspect byproduct, source, or special nuclear materials used or possessed within their borders. Any applicant other than a Federal agency who wishes to possess or use licensed material in one of these Agreement States needs to contact the responsible officials in that State for guidance on preparing an application; file these applications with State officials, not with the NRC.

In the special situation of work at Federally-controlled sites in Agreement States, it is necessary to know the jurisdictional status of the land in order to determine whether NRC or the Agreement State has regulatory authority. NRC has regulatory authority over land determined to be “exclusive Federal jurisdiction,” while the Agreement State has jurisdiction over non-exclusive Federal jurisdiction land. Licensees are responsible for finding out, in advance, the jurisdictional status of the specific areas where they plan to conduct licensed operations. NRC recommends that licensees ask their local contact for the Federal agency controlling the site (e.g., contract officer, base environmental health officer, district office staff) to help determine the jurisdictional status of the land and to provide the information in writing, so that licensees can comply with NRC or Agreement State regulatory requirements, as appropriate. Additional guidance on determining jurisdictional status is found in All Agreement States Letter, SP-96-022, dated February 16, 1996, which is available from NRC upon request.

Table 2.1 provides a quick way to check on which agency has regulatory authority.

Table 2.1 Who Regulates the Activity?

| Applicant and Proposed Location of Work | Regulatory Agency |
|--|-------------------|
| Federal agency regardless of location (except that Department of Energy [DOE] and, under most circumstances, its prime contractors are exempt from licensing [10 CFR 30.12]) | NRC |
| Non-Federal entity in non-Agreement State, US territory, or possession | NRC |
| Non-Federal entity in Agreement State at non-Federally controlled site | Agreement State |
| Non-Federal entity in Agreement State at Federally-controlled site <i>not</i> subject to exclusive Federal jurisdiction | Agreement State |
| Non-Federal entity in Agreement State at Federally-controlled site subject to exclusive Federal jurisdiction | NRC |

Figure 2.1 U.S. Map. *Location of NRC Offices and Agreement States.*

Reference: A current list of Agreement States (including names, addresses, and telephone numbers of responsible officials) is available by choosing “Directories” on the NRC Office of State Programs’ (OSP’s) Home Page <<http://www.hsr.d.ornl.gov/nrc/home.html>>. As an alternative, request the list from NRC’s Regional Offices.

All Agreement States Letter, SP-96-022, dated February 16, 1996, is available on OSP’s Home Page <<http://www.hsr.d.ornl.gov/nrc/home.html>>; choose “NRC-State Letters,” then choose “All of the Above,” and follow the directions for submitting a query for “SP96022.” As an alternative, request the letter from OSP; call NRC’s toll free number (800) 368-5642 and then ask for extension 415-3340.

3 Management Responsibility

The NRC recognizes that effective radiation safety program management is vital to achieving safe and compliant operations. NRC also believes that consistent compliance with its regulations provides reasonable assurance that licensed activities will be conducted safely. NRC also believes that effective management will result in increased safety and compliance.

“Management” refers to the processes for conduct and control of a radiation safety program and to the individuals who are responsible for those processes and who have *authority to provide necessary resources* to achieve regulatory compliance.

To ensure adequate management involvement, a duly authorized management representative *must* sign the submitted application acknowledging management’s commitments and responsibility for the following:

- Radiation safety, security and control of radioactive materials, and compliance with regulations;
- Completeness and accuracy of the radiation safety records and all information provided to NRC (10 CFR 30.9);
- Knowledge about the contents of the license and application;
- Compliance with current NRC and Department of Transportation (DOT) regulations and the licensee’s operating and emergency procedures;
- Commitment to provide adequate resources (including space, equipment, personnel, time, and, if needed, contractors) to the radiation protection program to ensure that public and workers are protected from radiation hazards and compliance with regulations is maintained;
- Selection and assignment of a qualified individual to serve as the Radiation Safety Officer (RSO) for their licensed activities;
- Prohibition against discrimination of employees engaged in protected activities (10 CFR 30.7);
- Commitment to provide information to employees regarding the employee protection and deliberate misconduct provisions in 10 CFR 30.7 and 10 CFR 30.10, respectively;
- Obtaining NRC’s prior written consent before transferring control of the license; and
- Notifying appropriate NRC regional administrator in writing, immediately following filing of petition for voluntary or involuntary bankruptcy (10 CFR 30.34(h)).

For information on NRC inspection, investigation, enforcement, and other compliance programs, see the current version of “General Statement of Policy and Procedures for NRC Enforcement Actions,” NUREG - 1600, and Inspection Procedure (IP) 87117, “Radiopharmacy Programs.” These documents are available electronically at <<http://www.nrc.gov>>. For hard copies of NUREG - 1600 and IP 87117, see the Notice of Availability (on the inside front cover of this report).

4 Applicable Regulations

It is the applicant's or licensee's responsibility to obtain up-to-date copies of applicable regulations, read and understand the requirements of each of these regulations, and comply with each applicable regulation. The following Parts of 10 CFR Chapter I contain regulations applicable to commercial radiopharmacies:

- 10 CFR Part 2, "Rules of Practice for Domestic Licensing Proceedings and Issuance of Orders";
- 10 CFR Part 19, "Notices, Instructions and Reports to Workers: Inspection and Investigations";
- 10 CFR Part 20, "Standards for Protection Against Radiation";
- 10 CFR Part 21, "Reporting of Defects and Noncompliance";
- 10 CFR Part 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material";
- 10 CFR Part 32, "Specific Domestic Licenses to Manufacture or Transfer Certain Items Containing Byproduct Material";

Part 32 allows licensees to prepare radioactive drugs for medical use, provided that the radioactive drug is prepared by either an authorized nuclear pharmacist (ANP) or an individual under the supervision of an ANP as specified in 10 CFR 35.25. In addition, Part 35 specifies the definition of an ANP and medical use in 35.2, and the qualifications of an ANP, in 10 CFR 35.980(b) and 35.972; however, the remaining sections of Part 35 do not apply to commercial radiopharmacy licensees.

- 10 CFR Part 71, "Packaging and Transportation of Radioactive Material";

Part 71 requires that licensees or applicants who transport licensed material or who may offer such material to a carrier for transport must comply with the applicable requirements of the DOT that are found in 49 CFR Parts 170 through 189. Copies of DOT regulations can be ordered from the Government Printing Office (GPO), whose address and telephone number are listed below

- 10 CFR Part 170, "Fees for Facilities, Materials, Import and Export Licenses and Other Regulatory Services Under the Atomic Energy Act of 1954, as Amended"; and
- 10 CFR Part 171, "Annual Fees for Reactor Operating Licenses, and Fuel Cycle Licenses and Materials Licenses, Including Holders of Certificates of Compliance, Registrations, and Quality Assurance Program Approvals and Government Agencies Licensed by NRC."

To request copies of the above documents, call GPO's order desk in Washington, DC at (202) 512-1800. Order the two-volume bound version of Title 10, Code of Federal Regulations, Parts 0-50 and 51-199 from the GPO, Superintendent of Documents, Post Office Box 371954, Pittsburgh, Pennsylvania 15250-7954. You may also contact the GPO electronically at <<http://www.gpo.gov>>. Single copies of the above documents may be requested from NRC's Regional Offices (see Figure 2.1 for addresses and telephone numbers). In addition, 10 CFR Parts 0-199 can be found on the NRC's website at <www.nrc.gov/nrc/cfr/index/html>.

Note that NRC and all other Federal Agencies publish amendments to their regulations in the Federal Register.

5 How to File

5.1 Paper Application

- Applicants for a materials license should do the following:
- Be sure to use the most recent guidance in preparing an application;
- Complete NRC Form 313 (Appendix A) Items 1 through 4, 12, and 13 on the form itself;
- Complete NRC Form 313 Items 5 through 11 on supplementary pages or use Appendix C;
- For each separate sheet, other than Appendix C, that is submitted with the application, identify and key it to the item number on the application or the topic to which it refers;
- Submit all documents on 8-1/2 x 11-inch paper;
- Avoid submitting proprietary information unless it is absolutely necessary; and
- Submit an original, signed application and one copy.

Retain one copy of the license application for future reference.

As required by 10 CFR 30.32(c), applications must be signed by duly authorized representative; see section on “Certification.”

Using the suggested wording of responses and committing to using the model procedures in this report will expedite NRC’s review.

All license applications will be available for review by the general public in NRC’s Public Document Rooms. If it is necessary to submit proprietary information, follow the procedure in 10 CFR 2.790. Failure to follow this procedure could result in disclosure of the proprietary information to the public or substantial delays in processing the application. Employee personal information, e.g., home address, home telephone number, Social Security Number, date of birth, or radiation dose information, should not be submitted unless specifically requested by NRC.

As explained in the “Foreword,” NRC’s new licensing process will be faster and more efficient, in part, through acceptance and processing of electronic applications at some future date. NRC will continue to accept paper applications; however, these will be scanned and put through an optical character reader to convert them to electronic format. To ensure a smooth transition, applicants are requested to follow these suggestions:

- Submit printed or typewritten, not handwritten, text on smooth, crisp paper that will feed easily into the scanner;
- Choose typeface designs that are sans serif, such as Arial, Helvetica, Futura, Univers; the text of this document is in a serif font called Times New Roman;
- Choose 12-point or larger font size;
- Avoid stylized characters such as script, italic, etc;
- Be sure the print is clear and sharp;
- Be sure there is high contrast between the ink and paper (black ink on white paper is best).

5.2 Electronic Application

As the electronic licensing process develops, it is anticipated that NRC may provide mechanisms for filing applications via diskettes or CD-ROM (compact disc-read only memory), and through the Internet. Additional filing instructions will be provided as these new mechanisms become available.

6 Where to File

Applicants wishing to possess or use licensed material in any State or U.S. territory or possession subject to NRC jurisdiction must file an application with the NRC Regional Office for the locale in which the material will be possessed and/or used. Figure 2.1 shows NRC's four Regional Offices and their respective areas for licensing purposes and identifies Agreement States.

In general, applicants wishing to possess or use licensed material in Agreement States must file an application with the Agreement State, not NRC; however, if work will be conducted at Federally controlled sites in Agreement States, applicants must first determine the jurisdictional status of the land in order to determine whether NRC or the Agreement State has regulatory authority. See the section on "Agreement States" for additional information.

7 License Fees

Each application for which a fee is specified, must be accompanied by the appropriate fee. Refer to 10 CFR 170.31 to determine the amount of the fee. NRC will not issue the licensing action prior to fee receipt. Consult 10 CFR 170.11 for information on exemptions from these fees. Once technical review has begun, no fees will be refunded; application fees will be charged regardless of the NRC's disposition of an application or the withdrawal of an application.

Most NRC licensees are also subject to annual fees; refer to 10 CFR 171.16. Consult 10 CFR 171.11 for information on exemptions from annual fees and 10 CFR 171.16(c) on reduced annual fees for licensees that qualify as "small entities."

Direct all questions about NRC's fees or completion of Item 12 of NRC Form 313 (Appendix B) to the Office of the Chief Financial Officer (OCFO) at NRC Headquarters in Rockville, Maryland, (301) 415-7554. Information about fees may also be obtained by calling NRC's toll free number (800) 368-5642, extension 415-7554. The e-mail address is fees@nrc.gov.

8 Contents of an Application

The following comments apply to the indicated items on NRC Form 313 (Appendix A).

All items in the application should be completed in enough detail for the NRC to determine that the proposed equipment, facilities, training and experience, and radiation safety program satisfy regulatory requirements and are adequate to protect health and minimize danger to life and property. Consideration shall be given, when developing your application, to the concepts of ALARA and the minimization of contamination.

Regarding ALARA, 10 CFR 20.1101(b) states that “The licensee *shall* use, to the extent practicable, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA).” ALARA concepts and philosophy are discussed in Regulatory Guide 8.10, “Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable.” Applications for commercial radiopharmacy licenses must address ALARA considerations in all aspects of their programs, e.g., monitoring and controlling external and internal personnel exposure, monitoring and controlling air and liquid effluents. ALARA considerations, including establishing administrative action levels and monitoring programs, need to be documented in the application.

10 CFR 20.1406 requires that license applicants describe how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste. Like ALARA, the applicant must address these concerns in all aspects of their programs.

All information submitted to NRC during the licensing process will be incorporated as part of the license and will be subject to review during inspection.

8.1 Item 1: License Action Type

THIS IS AN APPLICATION FOR (Check appropriate item)

| Type of Action | License No. |
|---|----------------|
| <input type="checkbox"/> A. New License | Not Applicable |
| <input type="checkbox"/> B. Amendment | XX-XXXXXX-XX |
| <input type="checkbox"/> C. Renewal | XX-XXXXXX-XX |

Check box A for a new license request.

Check box B for an amendment⁽¹⁾ to an existing license; provide license number.

Check box C for a renewal¹ of an existing license; provide license number.

8.2 Item 2: Applicant's Name and Mailing Address

List the legal name of the applicant's corporation or other legal entity with direct control over use of the radioactive material; a division or department within a legal entity may not be a licensee. An individual may be designated as the applicant only if the individual is acting in a private capacity and the use of the radioactive material is not connected with employment in a corporation or other legal entity. Provide the mailing address where correspondence should be sent. A Post Office box number is an acceptable mailing address.

Notify NRC of changes in mailing address; these changes do not require a fee.

Note: NRC must be notified before control of the license is transferred or when bankruptcy proceedings have been initiated. See below for more details. NRC Information Notice (IN) 97-30, "Control of Licensed Material during Reorganizations, Employee-Management Disagreements, and Financial Crises," dated June 3, 1997, discusses the potential for the security and control of licensed material to be compromised during periods of organizational instability.

Timely Notification of Transfer of Control

Regulations: 10 CFR 30.34(b).

Criteria: Licensees must provide full information and obtain NRC's *prior written consent* before transferring control of the license, or, as some licensees call it, "transferring the license."

Discussion: Transferring control may be the result of mergers, buyouts, or majority stock transfers. Although it is not NRC's intent to interfere with the business decisions of licensees, it is necessary for licensees to obtain prior NRC written consent. This is to ensure the following:

- Radioactive materials are possessed, used, or controlled only by persons who have valid NRC licenses;
- Materials are properly handled and secured;
- Persons using these materials are competent and committed to implementing appropriate radiological controls;
- A clear chain of custody is established to identify who is responsible for disposition of records and licensed material; and
- Public health and safety are not compromised by the use of such materials.

Response from Applicant: None from an applicant for a new license; Appendix F, excerpted from IN 89-25 (Rev. 1), "Unauthorized Transfer of Ownership or Control of Licensed Activities," dated December 7, 1994, identifies the information to be provided about transferring control.

Reference: See the Notice of Availability (on the inside front cover of this report) to obtain copies of IN 89-25 (Rev. 1), "Unauthorized Transfer of Ownership or Control of Licensed Activities," dated December 7, 1994, and IN 97-30, "Control of Licensed Material during

Reorganizations, Employee-Management Disagreements, and Financial Crises,” dated June 3, 1997. Information Notices are available on NRC’s website at www.nrc.gov/nrc/reference.html

Notification of Bankruptcy Proceedings

Regulation: 10 CFR 30.34(h).

Criteria: Immediately following filing of voluntary or involuntary petition for bankruptcy for or against a licensee, the licensee must notify the appropriate NRC Regional Administrator, in writing, identifying the bankruptcy court in which the petition was filed and the date of filing.

Discussion: Even though a licensee may have filed for bankruptcy, the licensee remains responsible for all regulatory requirements. NRC needs to know when licensees are in bankruptcy proceedings in order to determine whether all licensed material is accounted for and adequately controlled and whether there are any public health and safety concerns (e.g., contaminated facility). NRC shares the results of its determinations with other involved entities (e.g., trustee), so that health and safety issues can be resolved before bankruptcy actions are completed.

Response from Applicant: None at time of application for a new license. Licensees must immediately notify NRC following the filing of a voluntary or involuntary petition for bankruptcy for or against the licensee.

Reference: See the Notice of Availability (on the inside front cover of this report) to obtain copies of Policy and Guidance Directive PG 8-11, “NMSS Procedures for Reviewing Declarations of Bankruptcy,” dated September 8, 1996, and NRC Inspection Manual, Inspection Procedure 87103, “Inspection of Material Licensees Involved in an Incident or Bankruptcy Filing.”

8.3 Item 3: Address(es) Where Licensed Material Will Be Used or Possessed

Specify the street address, city, and state or other descriptive address (e.g., on Highway 10, 5 miles east of the intersection of Highway 10 and State Route 234, Anytown, State) for each facility. The descriptive address should be sufficient to allow an NRC inspector to find the facility location. Sketches or street maps indicating the location of the proposed facility would be helpful but are not required. A Post Office Box address is not acceptable.

Figure 8.1 Location of Use. *An acceptable location of use specifies street address, city, state, and zip code and does **not** include a post office box number.*

An NRC-approved license amendment is required before receiving, using and storing licensed material at an address or location not listed on the license.

Being granted an NRC license does not relieve a licensee from complying with other applicable Federal, State, or local regulations (e.g., local zoning requirements).

Note: As discussed later under “Financial Assurance and Record Keeping for Decommissioning,” licensees must maintain permanent records describing where licensed material was used or stored while the license was in force. This is important for making future determinations about the release of these locations for unrestricted use (e.g., before the license is terminated). Acceptable records are sketches, written descriptions of the specific locations or room numbers where licensed material is used or stored, and any records of spills or other unusual occurrences involving the spread of contamination in or around the licensee’s facilities.

8.4 Item 4: Person to Be Contacted about this Application

Identify the individual who can answer questions about the application, and include his or her telephone number. This individual, usually the Radiation Safety Officer, will serve as the point of contact during the review of the application and during the period of the license. If this individual is not a full-time employee of the licensed entity, his or her position and relationship should be specified. No individual other than the duly authorized applicant may, for any licensing matter, act on behalf of the applicant or provide information without the applicant’s written authorization. The NRC should be notified if the person assigned to this function changes or if their telephone number changes. Notification of a contact change is for information only and would not be considered an application for license amendment, unless the notification involves a change in the contact person who is also the Radiation Safety Officer.

As indicated on NRC Form 313 (Appendix A), Items 5 through 11 should be submitted on separate sheets of paper. Applicants may use Appendix C for this purpose and should note that using the suggested wording of responses and committing to using the model procedures in this report will expedite NRC’s review.

8.5 Item 5: Radioactive Material

8.5.1 Unsealed And/or Sealed Byproduct Material

Regulations: 10 CFR 30.33, 10 CFR 32.72(a)(3), 10 CFR 30.32(g), 10 CFR 32.210, 10 CFR 30.32(i).

Criteria: Applicants must submit information specifying each radionuclide requested; the form; and the maximum activity to be possessed at any one time. For sealed sources, the applicant must also submit the manufacturer and model number of each requested sealed source.

Discussion: Each authorized radioisotope is listed on an NRC license by its element name, form, and the maximum amount the licensee may possess at any one time (maximum possession limit), as shown in items 6, 7, and 8 of the sample license in Appendix E.

Requests to license naturally-occurring radioactive material (NORM) and accelerator-produced radioactive material should be made to the appropriate State regulatory agency. NRC does not regulate NORM or accelerator-produced radioactive material.

The applicant should list each requested radioisotope by its element name and its mass number (e.g., technetium-99m) in item 5. Note in the sample license in Appendix E that the NRC provides broad authorization to permit radiopharmacy licensees flexibility to prepare and distribute a range of radioisotopes as new radioactive drugs are developed. It is necessary to specify whether the material will be acquired and used in unsealed or sealed form. The name of the specific chemical compound that contains the radioisotope is not generally required.

For unsealed radioactive material, it is also necessary to specify whether requested radioisotopes will be handled in volatile or non-volatile form, since additional safety precautions are required when handling and using material in a volatile form. For example, when requesting authorization to possess and distribute iodine-131, the applicant must specify whether the material will be manipulated at the radiopharmacy in a volatile form (e.g., compounding of iodine-131 capsules) or received in the form in which it will be distributed (e.g., redistribution of sealed, unopened vials of iodine-131). Applicants requesting authorization to manipulate volatile radioactive material must describe appropriate facilities and engineering controls in response to Section 8.9, "Facilities and Equipment," and radiation safety procedures for handling of such material in specific responses to Section 8.10.4, "Occupational Dose;" Section 8.10.5, "Public Dose;" Section 8.10.6, "Safe Use of Radionuclides and Emergency Procedures;" and Section 8.10.7, "Surveys."

The anticipated possession limit in becquerels (Bq) or curies (Ci) for each radioisotope should also be specified. Possession limits must include the total anticipated inventory, including licensed material in storage and waste, and should be commensurate with the applicant's needs and facilities for safe handling. Applicants should review the requirements for submitting a certification for financial assurance for decommissioning before specifying possession limits of any radioisotope with a half life greater than 120 days. These requirements are discussed in the Section on Financial Assurance and Decommissioning.

Applicants will be authorized to possess and use only those sealed sources, such as calibration and reference sources, that are specifically approved or registered by the NRC or an Agreement State. A safety evaluation of sealed sources and devices is performed by the NRC or an Agreement State before authorizing a manufacturer (or distributor) to distribute them to specific licensees. The safety evaluation is documented in a Sealed Source and Device (SSD) Registration Certificate. Information on SSD registration certificates may be obtained by contacting the Registration Assistant by calling NRC's toll-free number, (800) 368-5642, extension 415-7231. Applicants must provide the manufacturer's name and model number for each requested sealed source and device, so that NRC can verify that they have been evaluated in an SSD Registration Certificate or specifically approved on a license.

Consult with the proposed supplier, manufacturer, or distributor to ensure that requested sources and devices are compatible with and conform to the sealed source and device designations

registered with NRC or an Agreement State. Licensees may not make any changes to the sealed source, device, or source/device combination that would alter the description or specifications from those indicated in the respective registration certificates, without obtaining NRC's prior permission in a license amendment. To ensure that applicants use sources and devices according to the registration certificates, they may want to get a copy of the certificate and review it or discuss it with the manufacturer.

A safety evaluation of sealed sources and devices is performed by NRC or an Agreement State before authorizing a manufacturer (or distributor) to distribute them to specific licensees. The safety evaluation is documented in an SSD Registration Certificate. Information on SSD registration certificates is available on the NRC's web site at <http://www.hsrdo.org/nrc/ssdrform.htm> and may also be obtained by contacting the Registration Assistant by calling NRC's toll free number, (800) 368-5642, Extension 415-7231. For additional guidance relating to sealed sources and devices, see also NUREG - 1556, Vol. 3., "Applications for Sealed Source and Device Evaluation and Registration."

The applicant must also request authorization to possess depleted uranium if it will be used for shielding of molybdenum-99/technetium-99m generators. Depleted uranium is frequently used as shielding for generators when the molybdenum-99 activity is greater than 148 gigabecquerels (4 curies). 10 CFR 40.13(c)(6) exempts depleted uranium from the requirements for a license to the extent that the material is used as a shipping container, such as when molybdenum-99/technetium-99m generators are in transit from their manufacturer to the pharmacy; however, a specific license or authorization from the NRC is needed to possess and use the depleted uranium as a shield during the time that the pharmacy uses or stores the generator at its facility. The applicant must specify the total amount of depleted uranium, in kilograms, that will be needed.

If an applicant requests quantities of licensed material in excess of 10 CFR 30.72, "Schedule C - Quantities of Radioactive Materials Requiring Consideration of the Need for an Emergency Plan for Responding to a Release," the applicant must either submit an emergency plan for responding to a release of radioactive materials or perform an evaluation showing that the maximum dose to a person offsite due to a release of radioactive materials would not exceed 10 millisieverts (mSv) (1 rem) effective dose equivalent or 50 mSv (5 rems) to the thyroid. For radiopharmacies, iodine-131 is the radionuclide most likely to trigger the need for an emergency plan due to its Schedule C quantity of 10 curies.

Licensees must submit a license amendment and receive NRC authorization before they may make changes in the types, forms, and quantities of materials possessed.

Response from Applicant:

- For unsealed materials:
 - Identify each radionuclide (element name and mass number) that will be used, the form, and the maximum requested possession limit.

AND

- For potentially volatile materials (e.g., iodine-131):
 - Specify whether open containers of the materials will be manipulated at the radiopharmacy.
- For sealed materials:
 - Identify each radionuclide (element name and mass number) that will be used in each source;
 - Provide the manufacturer's (distributor's) name and model number for each sealed source and device requested;
 - Confirm that each sealed source, device, and source/device combination is registered as an approved sealed source or device by NRC or an Agreement State; and
 - Confirm that the activity per source and maximum activity in each device will not exceed the maximum activity listed on the approved certificate of registration issued by NRC or by an Agreement State.
- For depleted uranium, specify the total amount (in kilograms).

8.5.2 Financial Assurance and Recordkeeping for Decommissioning

Regulations: 10 CFR 30.35, 10 CFR 30.34(b).

Criteria: A licensee authorized to possess radioactive material in excess of the limits specified in 10 CFR 30.35 must submit a decommissioning funding plan (DFP) or provide a certification of financial assurance (FA) for decommissioning. Even if a DFP or FA is not required, licensees are required to maintain, in an identified location, decommissioning records related to structures and equipment where radioactive materials are used or stored and related to leaking sources. Pursuant to 10 CFR 30.35(g), licensees must transfer records important to decommissioning to either of the following:

- The new licensee before licensed activities are transferred or assigned according to 10 CFR 30.34(b); or
- The appropriate NRC regional office before the license is terminated.

Discussion: The requirements for financial assurance are specific to the types and quantities of byproduct material authorized on a license. Most commercial radiopharmacy applicants and licensees do not need to take any action to comply with the financial assurance requirements, because the vast majority of radioactive materials they possess and redistribute do not have half-lives greater than 120 days and the total inventory of licensed materials with half-lives greater than 120 days do not exceed the thresholds in 10 CFR 30.35(b) and (d).

Applicants requesting more than one radionuclide may determine whether financial assurance for decommissioning is required by calculating, for each radionuclide with a half-life greater than 120 days possessed, the ratio between the activity possessed, in curies, and the radionuclide's threshold activity requiring financial assurance, in curies. If the sum of such ratios for all of the radionuclides possessed exceeds "1" (i.e., "unity"), then applicants must submit evidence of financial assurance for decommissioning.

The same regulation also requires that licensees maintain records important to decommissioning in an identified location. All commercial nuclear pharmacy licensees need to maintain records of structures and equipment where radioactive material was used or stored. As-built drawings with modifications of structures and equipment shown as appropriate fulfill this requirement. If drawings are not available, licensees shall substitute appropriate records (e.g., a sketch of the room or building or a narrative description of the area) concerning the specific areas and locations. If no records exist regarding structures and equipment where radioactive materials were used or stored, licensees shall make all reasonable efforts to create such records based upon historical information (e.g. employee recollections). In addition, if radiopharmacy licensees have experienced unusual occurrences (e.g., incidents that involve spread of contamination, leaking sources), they also need to maintain records about contamination that remains after cleanup or that may have spread to inaccessible areas.

For radiopharmacy licensees whose contamination incidents did not involve radioactive materials with half-lives exceeding 120 days and whose sealed sources have never leaked, acceptable records important to decommissioning are sketches or written descriptions of the specific locations where radioactive material was used or stored.

Response from Applicant: No response is needed from most applicants. If financial assurance is required, submit the documentation required under 10 CFR 30.35. Regulatory Guide (RG) 3.66, “Standard Format and Content of Financial Assurance Mechanisms Required for Decommissioning Under 10 CFR Parts 30, 40, 70, and 72,” dated June 1990, contains approved wording for each of the mechanisms authorized by the regulation to guarantee or secure funds except for the Statement of Intent for Government licensees.

Licensees must transfer records important to decommissioning either to the new licensee before licensed activities are transferred or assigned in accordance with 10 CFR 30.34(b) or to the appropriate NRC regional office before the license is terminated.

References: See Notice of Availability (on the inside front cover of this report) to obtain copies of RG 3.66, “Standard Format and Content of Financial Assurance Mechanisms Required for Decommissioning Under 10 CFR Parts 30, 40, 70, and 72,” dated June 1990, and Policy & Guidance Directive (P&GD) FC 90-2, Revision 1, “Standard Review Plan for Evaluating Compliance with Decommissioning Requirements,” dated April 30, 1991.

8.6 Item 6: Purpose(s) for Which Licensed Material Will Be Used

Figure 8.2 Purpose Wheel. *The distribution of radioactive materials by commercial radiopharmacies is authorized by several distinct regulations. The appropriate regulation to refer to depends on the nature of the material, the purpose(s) for which it will be used, and to whom it is sent.*

8.6.1 Distribution and Redistribution of Sealed and Unsealed Materials

Regulations: 10 CFR 30.41; 10 CFR 32.71; 10 CFR 32.72; and 10 CFR 32.74.

Criteria: The applicant must specify the radioactive material it intends to distribute and redistribute.

Discussion: Radiochemicals are those materials that either require further manipulation to be suitable for human use or are not intended for human use. Examples include raw materials received from a non-10 CFR 32.72 supplier (chemical grade materials). Radioactive drugs are those materials suitable for human use and include radiobiologics (e.g., monoclonal antibodies and technetium-99m-tagged red blood cells) and radiopharmaceuticals. However, the terms, “radiopharmaceutical” and “radioactive drug” will be used interchangeably in this guidance document, and reference to one is not meant to exclude the other.

Distribution activities are normally classified as either “distribution” or “redistribution.” “Distribution” applies to those radioactive drugs and radiochemicals initially prepared by the pharmacy. “Redistribution” refers to those materials received from another person, authorized pursuant to either 10 CFR 32.71, 10 CFR 32.72, or 10 CFR 32.74, depending on the product distributed, i.e., *in vitro* kits, other radiopharmaceuticals, or sealed sources for medical use, respectively. The distribution of radioactive materials to other persons requires specific approval from the NRC, either by NRC regulation or by a license authorizing the activity. The initial distribution of radioactive drugs for medical use must be prepared by a person licensed pursuant to 10 CFR 32.72. The redistribution of *in vitro* kits and sealed sources containing byproduct material for medical use is authorized pursuant to 10 CFR 32.71 and 32.74, respectively, provided that the materials are not repackaged and the labels are not altered. The *in vitro* kits and sealed sources for medical use intended for redistribution must be initially distributed by a person licensed pursuant to 10 CFR 32.71 or 10 CFR 32.74, respectively. The transfer of radioactive materials for non-medical use, including radiochemicals, and sealed calibration and reference sources, is authorized pursuant to 10 CFR 30.41.

All radioactive material listed above shall be distributed only to persons authorized by an NRC or Agreement State license to receive such materials, or by a general license (10 CFR 31.11, or equivalent Agreement State regulation) to receive *in vitro* test materials.

Initial distribution of unsealed byproduct material in the form of radiopharmaceuticals intended for human diagnostic and therapeutic use by medical licensees comprises the bulk of virtually all radiopharmacy activities. Prior to the transfer, distribution, or redistribution of any licensed material, the radiopharmacy must verify that the transferee’s license authorizes the receipt of the type, form, and quantity of byproduct material to be transferred. The pharmacy should verify that the address to which radioactive materials are delivered is an authorized location of use listed on the customer’s license. 10 CFR 30.41(d) lists five methods that can be used to meet the license verification requirement. The most common form of verification is for the radiopharmacy to possess a valid copy of the customer’s NRC or Agreement State license or other applicable document (e.g. *in vitro* registration certificate/NRC Form 483).

Response From Applicant: Provide the following, as applicable:

For radiopharmaceuticals:

Confirm that radiopharmaceuticals will be prepared under the supervision of an ANP or will be obtained from a supplier authorized pursuant to 10 CFR 32.72, or under equivalent Agreement State requirements; and

Describe all licensed material to be distributed or redistributed.

For generators:

- Confirm that the generators will be obtained from a manufacturer licensed pursuant to 10 CFR 32.72, or under equivalent Agreement State requirements; and
- Confirm that unused generators will be redistributed without opening or altering the manufacturer's packaging.

For redistribution of used generators:

- Describe the procedures and instructions for safely repackaging the generators, including the use of the manufacturer's original packaging and minimization of migration of radioactive fluids out of the generator during transport;
- Confirm that the manufacturer's packaging and labeling will not be altered;
- Confirm that the generator will not be distributed beyond the expiration date shown on the generator label;
- Confirm that the redistributed generator will be accompanied by the manufacturer-supplied leaflet or brochure that provides radiation safety instructions for handling and using the generator; and
- Confirm that only generators used in accordance with the manufacturer's instructions will be redistributed.

Note: Although redistribution of used generators may be authorized by the NRC, NRC approval does not relieve the licensee from complying with applicable FDA or other Federal and State requirements.

For redistribution of sealed sources — for brachytherapy or diagnosis:

- Confirm that the sealed sources for brachytherapy or diagnosis to be redistributed will be obtained from a manufacturer authorized to distribute sealed sources for brachytherapy or diagnosis in accordance with a specific license issued pursuant to 10 CFR 32.74, or under equivalent Agreement State requirements; and
- Confirm that the manufacturer's packaging, labeling, and shielding will not be altered and that redistributed sources will be accompanied by the manufacturer-supplied package insert, leaflet, brochure, or other document that provides radiation safety instructions for handling and storing the sources.

For redistribution of calibration and reference sealed sources:

- Confirm that calibration and reference sealed sources to be redistributed to medical use licensees will be obtained from a person licensed pursuant to 10 CFR 32.74 or under

- equivalent Agreement State requirements, to initially distribute such sources; and
- Confirm that the manufacturer's labeling and packaging will not be altered and that redistributed sources will be accompanied by the manufacturer-supplied calibration certificate and the leaflet, brochure, or other document that provides radiation safety instructions for handling and storing the sources.

For redistribution of prepackaged units for *in vitro* tests:

- Confirm that the prepackaged units for *in vitro* tests to be redistributed will have been obtained from a manufacturer authorized to distribute the prepackaged units for *in vitro* tests in accordance with a specific license issued pursuant to 10 CFR 32.71, or under an equivalent license of an Agreement State.

For redistribution to general licensees:

- Confirm that the manufacturer's packaging and labeling of the prepackaged units for *in vitro* tests will not be altered in any way; and
- Confirm that each redistributed prepackaged unit for *in vitro* tests will be accompanied by the manufacturer-supplied package insert, leaflet, or brochure that provides radiation safety instructions for general licensees.

For redistribution to specific licensees:

- Confirm that the labels, package insert, leaflet, brochure, or other documents accompanying the redistributed prepackaged units for *in vitro* tests will NOT reference general licenses, exempt quantities, or NRC's regulations that authorize a general license (e.g., 10 CFR 31.11); and
- Confirm that the labeling on redistributed prepackaged units for *in vitro* tests will conform to the requirements of 10 CFR 20.1901 and 20.1904.

8.6.2 Preparation of Radiopharmaceuticals

Regulation: 10 CFR 32.72(b). **Criteria:** The preparation of radiopharmaceuticals for commercial distribution to medical users requires specific authorization.

Discussion: The bulk of radiopharmacy activities involve the preparation of radiopharmaceuticals for commercial distribution to medical users.

Response From Applicant: The applicant should indicate the types of radiopharmaceutical preparation activities it intends to perform (e.g., compounding of iodine-131 capsules, radioiodination, and technetium-99m kit preparation).

8.6.3 Sealed Sources for Calibration and Checks and Possession of Depleted Uranium

Regulation: 10 CFR 30.33; 10 CFR 30.32(g); 10 CFR 32.210.

Criteria: The applicant must specify the uses for sealed sources for reference and calibration

and depleted uranium for shielding.

Discussion: The applicant should describe the intended use of sealed sources. This will normally be for calibration and checks performed only on the applicant's instruments and equipment. Any sources intended for use in a specific instrument calibration device should be identified, along with the manufacturer and model number of the device. The use of depleted uranium for shielding, (e.g., incorporated into molybdenum-99/technetium-99m generators) should also be specified, if appropriate.

Response from Applicant: Supply specific information concerning the use of sealed sources for reference and calibration and depleted uranium.

8.6.4 Service Activities

Regulation: 10 CFR 30.33(a)(1).

Criteria: The applicant must specify the radiation protection services it intends to provide to other licensees (e.g., customers), if the service involves the applicant's possession of licensed material (calibration sources and leak test samples).

Discussion: If the applicant intends to provide radiation protection services to customers, the services must be described. Typically these services include instrument calibration and sealed source leak testing. Specific guidance regarding requests to provide service activities is included in Draft Regulatory Guides FC 412-4, "Guide for the Preparation of Applications for Licenses for the Use of Radioactive Materials in Leak-Testing Services," and FC 413-4, "Guide for the Preparation of Applications for Licenses for the Use of Radioactive Materials in Calibrating Radiation Survey and Monitoring Instruments."

Response from Applicant: Specify the customer radiation protection services involving licensed material that will be provided. The applicant must submit specific procedures for all service activities that it intends to provide.

References: See the Notice of Availability on the inside front cover of this report to obtain copies of:

- Draft Regulatory Guide FC 412-4, "Guide for the Preparation of Applications for Licenses for the Use of Radioactive Materials in Leak-Testing Services"; and
- Draft Regulatory Guide FC 413-4, "Guide for the Preparation of Applications for Licenses for the Use of Radioactive Materials in Calibrating Radiation Survey and Monitoring Instruments"

8.7 Item 7: Individual(s) Responsible for Radiation Safety Program and Their Training Experience

Regulations: 10 CFR 30.33(a)(3).

Criteria: The Radiation Safety Officer (RSO), Authorized Users (AUs), and Authorized Nuclear Pharmacists (ANPs) must have adequate training and experience.

Discussion: Individuals responsible for the radiation protection program are licensee senior management, the RSO, ANPs, and AUs. NRC requires that an applicant be qualified by training and experience to use licensed materials for the purposes requested in such a manner as to protect health and minimize danger to life or property. Subpart J of 10 CFR Part 35 and 10 CFR 32.72(b) give specific criteria for acceptable training and experience for ANPs. The minimum training and experience criteria for RSOs and AUs, though not specifically described in NRC's regulations for radiopharmacy licensees, should include a bachelor's degree in a physical science, or equivalent, and previous experience handling and supervising similar activities. Applicants should note that a résumé or a curriculum vitae does not usually supply all the information needed to evaluate an individual's training and experience.

NRC holds the licensee responsible for the radiation protection program; therefore, it is essential that strong management controls and oversight exist to ensure that licensed activities are conducted properly. Management responsibility and liability are sometimes underemphasized or not addressed in applications and are often poorly understood by licensee employees and managers. Senior management should delegate to the RSO, in writing, sufficient authority, organizational freedom, and management prerogative to communicate with and direct personnel regarding NRC regulations and license provisions and to terminate unsafe activities involving byproduct material. The licensee maintains the ultimate responsibility, nevertheless, for the conduct of licensed activities.

Response from Applicant: Refer to the subsequent sections specific to the individuals described above. Applicants should submit an organizational chart describing the management structure, reporting paths, and the flow of authority between executive management and the RSO.

8.7.1 Radiation Safety Officer (Rso)

Regulations: 10 CFR 30.33(a)(3).

Criteria: Each licensee must appoint a qualified individual to act as the Radiation Safety Officer (RSO). The RSO must have adequate training and experience.

Discussion: NRC requires the name, training, and experience of the proposed RSO to ensure that the applicant has identified a responsible, qualified person to oversee the radiation safety program. When selecting an RSO, the applicant should keep in mind the duties and responsibilities of the position, and select an individual who is qualified and has the time and resources to fulfill those duties and responsibilities. Typical duties and responsibilities of a radiopharmacy RSO are included in Appendix H.

The RSO needs a level of basic technical knowledge sufficient to understand the work to be

performed with byproduct materials at the radiopharmacy and to be qualified by training and experience to perform the duties required for that position. Any individual who has sufficient training and experience to be named as an authorized nuclear pharmacist (ANP) is also considered qualified to serve as the facility RSO. The same is true for an authorized user (AU) who has had adequate training and experience in the radiation safety aspects associated with the use of similar types of byproduct material.

The training and experience requirements for the RSO may be met by any of the following:

- Qualification as an ANP;
- Identification as an AU on the license and experience in the use of the types and quantities of licensed material for which the individual has RSO responsibilities; and
- Didactic and work experience.

In order to demonstrate adequate training and experience, the RSO should have (1) as a minimum, a college degree at the bachelor level, or equivalent training and experience in physical, chemical, biological sciences, or engineering; and (2) training and experience commensurate with the scope of proposed activities. Training should include the following subjects:

- Radiation protection principles;
- Characteristics of ionizing radiation;
- Units of radiation dose and quantities;
- Radiation detection and measurement instrumentation;
- Biological hazards of exposure to radiation (appropriate to types and forms of byproduct material to be used);
- NRC regulatory requirements and standards; and
- Hands-on use of radioactive materials commensurate with the uses proposed by the applicant.

The length of training and experience will depend upon the type, form, quantity, and proposed use of the licensed material requested. The proposed RSO's training and experience should be sufficient to identify and control the anticipated radiation hazards. The requisite training may be obtained from formal courses consisting of lectures and laboratories designed for RSOs presented by academic institutions, commercial radiation safety consulting companies, or appropriate professional organizations. Each hour of training may be counted only once and should be allocated to the most representative topic.

On-the-job training may not be counted toward the hours documenting length of training unless it was obtained as part of a formal training course. A "formal" training course is one that incorporates the following elements:

- A detailed description of the content of the course is maintained on file at the sponsoring institution and can be made available to the NRC upon request;
- Evidence that the sponsoring institution has examined the student's knowledge of the course content is maintained on file at the institution and can be made available to NRC upon request. This evidence of the student's overall competency in the course material should include a final grade or percentile; and
- A permanent record that the student successfully completed the course is kept at the

institution.

Response from Applicant: Provide the following:

- Name of the proposed RSO;

AND

- A copy of the license (NRC or Agreement State) that authorized the uses requested and on which the individual was specifically named as the RSO, an ANP, or an AU;

OR

- Description of the training and experience demonstrating that the proposed RSO is qualified by training and experience applicable to commercial nuclear pharmacies.

Note: See Appendix G for convenient formats to use for documenting hours of training in basic radioisotope handling techniques and hours of experience using radioisotopes. Figures G-1 and G-2 are specific to RSO training and experience.

8.7.2 Authorized Nuclear Pharmacist (Anp)

Regulations: 10 CFR 32.72 (b)(2) and (4); 10 CFR 35.2; 10 CFR 35.972; and 10 CFR 35.980.

Criteria: ANP must be a State-licensed or State-registered pharmacist with adequate training and experience.

Discussion: Each commercial nuclear pharmacy must have an authorized nuclear pharmacist to prepare or supervise the preparation of radioactive drugs for medical use. Any individual who is not qualified to be an authorized nuclear pharmacist may work under the supervision of an authorized nuclear pharmacist.

The criteria for a pharmacist to work as an ANP at a commercial radiopharmacy are described in 10 CFR 32.72 (b)(2) and (4). This section of the regulation refers to the definition of an ANP in 10 CFR 35.2, "Definitions," the training and experience criteria described in 10 CFR 35.980, "Training for an Authorized Nuclear Pharmacist," and recentness criteria described in 10 CFR 35.972, "Recentness of Training." Successful completion of training as described in 10 CFR 35.980, within 7 years preceding the date of the application, is evidence of adequate training and experience. Additional training and experience may be necessary if the time interval is greater than 7 years. Applicants may find it convenient to present this documentation using a format similar to Figures G-3 and G-4 in Appendix G. Each hour of training may be listed only once, (i.e., under the most applicable category). The recentness of training requirements apply to board certification as well as to other recognized training pathways.

On-the-job training may not be counted toward the hours listed above unless it was obtained as part of a formal training course. A "formal" training course is one that incorporates the following elements:

A detailed description of the content of the course is maintained on file at the sponsoring institution and can be made available to the NRC upon request;

- Evidence that the sponsoring institution has examined the student's knowledge of the course content is maintained on file at the institution and can be made available to NRC upon request. This evidence of the student's overall competency in the course material should include a final grade or percentile; and
- A permanent record that the student successfully completed the course is kept at the institution.

Response from Applicant: For each proposed ANP, provide the following:

- Name of the pharmacist;

AND

- A copy of the State pharmacy licensure or registration for the pharmacist;

AND

- A copy of the license (NRC or Agreement State) on which the individual was specifically named as an ANP;

OR

- A copy of the permit maintained by a licensee of broad scope that identifies the individual as ANP;

OR

- A copy of previous NRC license issued to a commercial radiopharmacy prior to December 2, 1994, on which the pharmacist was specifically named as an authorized user;

OR

- A copy of the pharmacist's certification(s) from the radiopharmacy board(s) approved by the NRC;

OR

- Description of the training and experience demonstrating that the proposed ANP is qualified by training and experience; and written certification, signed by a preceptor ANP, that the above training and experience has been satisfactorily completed and that the individual has achieved a level of competency sufficient to independently operate a nuclear pharmacy;

AND

- Description of the recentness of training, if necessary.

Note: ANPs approved by corporate nuclear pharmacy radiation safety committees are not recognized under the criteria under 10 CFR 32.72 (b). For these individuals, the applicant must provide a description of their training and experience to the NRC for review.

8.7.3 Authorized Users (Au)

Regulations: 10 CFR 30.33(a)(3).

Criteria: Authorized users (AUs) must have adequate training and experience with the types and quantities of licensed material that they propose to use.

Discussion: If the applicant intends to perform functions other than the preparation and distribution of radioactive drugs, the applicant may request that an individual other than an ANP perform and/or supervise those functions. This individual, if approved, would be designated on the license as an AU. These other functions may include leak testing of sealed sources or instrument calibration services for the pharmacy and its customers; however, the term Authorized User, as used in this document should not be confused with the definition of an “Authorized User” contained in 10 CFR 35.2 for medical use.

In order to demonstrate adequate training and experience, the proposed AU should have (1) as a minimum, a college degree at the bachelor level, or equivalent training and experience in physical, chemical, biological sciences, or engineering; and (2) training and experience commensurate with the scope of proposed activities. Training should include the following subjects:

- Radiation protection principles;
- Characteristics of ionizing radiation;
- Units of radiation dose and quantities;
- Radiation detection and measurement instrumentation;
- Biological hazards of exposure to radiation (appropriate to types and forms of byproduct material to be used);
- NRC regulatory requirements and standards; and
- Hands-on use of radioactive materials commensurate with uses proposed by the applicant.

The length of training and experience listed above will depend upon the type, form, quantity, and proposed use of the licensed material requested. The proposed AU's training and experience should be sufficient to identify and control the anticipated radiation hazards. The above training may be obtained from formal radiation safety courses consisting of lectures and laboratories presented by academic institutions, commercial radiation safety consulting companies, or appropriate professional organizations. Each hour of training may be counted only once and should be allocated to the most representative topic.

On-the-job training may not count toward the hours listed above unless it was obtained as part of a formal training course. A “formal” training course is one that incorporates the following elements:

- A detailed description of the content of the course is maintained on file at the sponsoring institution and can be made available to the NRC upon request;
- Evidence that the sponsoring institution has examined the student's knowledge of the course content is maintained on file at the institution and can be made available to NRC upon request. This evidence of the student's overall competency in the course material should include a final grade or percentile; and
- A permanent record that the student successfully completed the course is kept at the

institution.

The AU must demonstrate training and experience with the type and quantity of material that is to be used at the pharmacy. For example, someone with training and experience only with microcurie quantities of unsealed radioactive material may not be qualified to use or supervise the use of higher activity sealed radioactive sources for instrument calibration. Applicants should pay particular attention to the type of radiation involved. For example, someone experienced with gamma emitters may not have appropriate experience for high energy beta emitters.

Response from Applicant: For each proposed Authorized User (AU):

- Name of each proposed AU;

AND

- Identify types, quantities, and proposed uses of licensed material;

AND

- A copy of license (NRC or Agreement State) on which the individual was specifically named as an AU for the types, quantities, and proposed uses of licensed materials;

OR

- A copy of the permit maintained by a licensee of broad scope that identifies the individual as an AU for the types, quantities, and proposed uses of licensed materials;

OR

- Description of the training and experience demonstrating that the proposed AU is qualified by training and experience to use the requested licensed materials. The applicant may find it convenient to describe this training and experience using a format similar to Figures G-1 and G-2 in Appendix G.

8.8 Item 8: Training for Individuals Working in or Frequenting Restricted Areas (Instructions to Occupationally Exposed Workers and Ancillary Personnel)

8.8.1 Occupationally Exposed Workers and Ancillary Personnel

Regulations: 10 CFR 19.12, 10 CFR 20.1101(a), and 10 CFR 30.33(a)(3).

Criteria: Individuals working with licensed material must receive radiation safety training commensurate with their assigned duties and specific to the licensee's radiation safety program. In addition, those individuals who, in the course of employment, are likely to receive in a year a dose in excess of 100 mrem (1 mSv) must be instructed according to 10 CFR 19.12.

Discussion: 10 CFR 20.1101(a) requires each licensee to develop, document, and implement a

radiation protection program commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with Part 20. Each individual working with radioactive material must be trained in the radiation safety procedures applicable to their job before beginning work with licensed materials. Licensees should not assume that safety instruction has been adequately covered by prior employment or training. Practical, site-specific training should be provided for all individuals prior to beginning work with, or in the vicinity of, licensed material. Training should also be performed whenever there is a significant change in duties, procedures, regulations, or terms of the license. Each individual should also receive periodic refresher training at a frequency sufficient to ensure that all staff remain adequately trained.

Additional training is required if an individual is likely to receive a dose in excess of 1 mSv (100 mrem) in a year. ANPs and others involved in the preparation of radiopharmaceuticals are most likely to receive doses in excess of 1 mSv (100 mrem) in a year; however, potential radiation doses received by all employees must also be evaluated. The evaluation must include consideration of assigned activities during both normal and abnormal situations involving exposure to radiation and/or radioactive material that can reasonably be expected to occur during licensed activities.

If individuals making deliveries of radioactive material at the licensee's facility are likely to receive a dose in excess of 1 mSv (100 mrem) in a year from the licensee's activities, the licensee is responsible for ensuring that the person has received the training specified in 10 CFR Part 19, regardless of whether that person is an employee of the licensee. If the training has been provided by someone else (such as the shipper or another licensee), the licensee does not have to provide training except for instruction in site-specific radiation hazards. This issue is discussed in NRC Generic Letter 95-09, "Monitoring and Training of Shippers and Carriers of Radioactive Materials," dated November 3, 1995.

Training may be in the form of lecture, demonstrations, videotape, or self-study, and should emphasize practical subjects important to the safe use of licensed material. A method should be provided for individuals receiving instructions and training to ask questions. The licensee should determine whether the training succeeded in conveying the desired information and adjust the training program as necessary. The person conducting the training should be a qualified individual (e.g., the RSO, an ANP, AU, or radiation safety professional familiar with the licensee's program).

Licensee personnel who work in the vicinity of, but do not handle radioactive materials (ancillary staff), are not required to have radiation safety training as long as they are not likely to receive 1 mSv (100 mrem) in a year; however, to minimize potential radiation exposure when ancillary staff are working in the vicinity of radioactive material, it is prudent for them to work under the supervision and in the physical presence of an ANP/AU or to be provided some basic radiation safety training. Such ancillary staff should be informed of the nature and location of the radioactive material and the meaning of the radiation symbol, and should be instructed not to handle radioactive materials and to keep away from it as much as their work permits.

Some ancillary staff, although not likely to receive doses over 1 mSv (100 mrem), should receive

training to ensure adequate security and control of licensed material. Licensees may provide these individuals with training commensurate with their assignments in the vicinity of the radioactive material to ensure the control and security of the material.

The guidance in Appendix N may be used by the applicant to develop a training program.

Response from Applicant: State, “We have developed and will implement and maintain written procedures for a training program for each group of workers, including: topics covered; qualifications of the instructors; method of training; method for assessing the success of the training; and the frequency of training and refresher training.”

References: For hard copies of NRC Generic Letter 95-09, “Monitoring and Training of Shippers and Carriers of Radioactive Materials,” dated November 3, 1995, see the Notice of Availability (on the inside front cover of this report).

8.8.2 Personnel Involved in Hazardous Materials Package Preparation and Transport

Regulation: 49 CFR 172.700; 49 CFR 172.702; 49 CFR 172.704.

Criteria: Applicants must train personnel involved in the preparation and transport of hazardous material packages in the applicable DOT regulations.

Discussion: Licensees who prepare packages of radioactive materials or who transport their own packages must provide training to their employees who perform those functions. The training must include:

- General awareness and familiarization training designed to provide familiarity with DOT requirements, and the ability of the employee to recognize and identify hazardous materials;
- Function-specific training concerning the DOT requirements that are specifically applicable to the functions the employee performs, (e.g., if the employee’s duties require affixing DOT radioactive labels to packages, the employee must receive training in DOT’s regulations governing package labeling); and
- Safety training concerning emergency response information, discussed above; measures to protect the employee and other employees from the hazards associated with the hazardous materials to which they may be exposed to in the workplace; and methods of avoiding accidents, such as the proper procedures for handling packages containing hazardous materials.

The training must be provided initially, and every 3 years thereafter. Records of training must be maintained.**Note:** The licensee is not responsible for providing DOT-required hazardous materials training to common carriers to whom the pharmacy offers radioactive materials packages for transport.

Response from Applicant: Submit the following statement: “We have developed and will implement and maintain written procedures for training personnel involved in hazardous materials package preparation and transport that meet the requirements in 49 CFR 172.700, 49 CFR 172.702, and 49 CFR 172.704, as applicable.”

8.8.3 Instruction for Supervised Individuals Preparing Radiopharmaceuticals

Regulation: 10 CFR 32.72(b)(1); 10 CFR 35.25(b).

Criteria: Individuals who prepare byproduct material for medical use under the supervision of an authorized nuclear pharmacist must be instructed in the preparation of byproduct material for medical use, the principles of radiation safety, and the licensee’s procedures for the use of byproduct material; follow the instructions given; and must have their work and records kept to reflect their work periodically reviewed by the supervising ANP.

Discussion: The applicant must instruct supervised individuals in the preparation of byproduct material for medical use and require those individuals to follow their instructions, the written radiation protection program, license conditions, and NRC regulations. The supervising ANP must review the work of supervised individuals in the preparation of byproduct material for medical use and the records kept to reflect that work. If an authorized nuclear pharmacist is always physically present when radioactive drugs are prepared, supervision may be fulfilled by the day-to-day instruction and review of the supervised individual by the ANP.

An ANP is considered to be supervising the use of radioactive materials when directing personnel in the conduct of operations involving licensed materials. The ANP need not be present at all times during the use of such materials; however, the supervising ANP is responsible for ensuring that personnel under supervision have been properly trained and instructed. The supervising ANP is therefore responsible for the supervision of operations involving the use of radioactive materials whether or not he or she is present.

NRC regulations do not relieve the licensee from complying with applicable Department of Health and Human Services (Food and Drug Administration), other Federal, and State requirements governing radioactive drugs. From an NRC perspective, if the supervision requirements are met, it is permissible for the licensee to allow the supervised individual to prepare radiopharmaceuticals without the presence of the ANP; however, some States require that a pharmacist be physically present during the preparation and dispensing of pharmaceuticals, including radioactive drugs. It is the licensee’s responsibility to ensure that its practices comply with any additional State requirements concerning this issue.

Response from Applicant: No response from the applicant is necessary. Supervision will be reviewed during inspection.

8.9 Item 9: Facilities and Equipment

Regulations: 10 CFR 32.72(a)(2); 10 CFR 30.33(a)(2), 10 CFR 20.1406, 10 CFR 20.1101(b), 10 CFR 30.35 (g).

Criteria: Radiopharmacies must demonstrate that they are a pharmacy. Facilities and equipment must be adequate to protect health and minimize danger to life or property, minimize the likelihood of contamination, and keep exposures to workers and the public ALARA.

Discussion: Applicants must demonstrate that they are a pharmacy by submitting evidence of at least one of the following:

- Licensure as a pharmacy by a State Board of Pharmacy; and
- Operation as a nuclear pharmacy within a Federal medical institution.

If the registration or license has not been issued by the State Board of Pharmacy at the time of application, the applicant may provide it at a later date, but prior to license issuance from NRC.

Applicants must provide NRC with documentation demonstrating that their facilities and equipment provide sufficient engineering controls and barriers to protect the health and safety of the public and their employees. The facilities and equipment must also keep exposures to radiation and radioactive materials ALARA, and minimize the risks from the uses of the types and quantities of radioactive materials. The applicant should provide clear delineations between its restricted and unrestricted areas through the use of barriers, postings, and worker instructions.

Applicants may delay completing facilities and acquiring equipment until after the application review is completed, in case changes are required as a result of the application review. This also ensures the adequacy of the facilities and equipment before the applicant makes a significant financial commitment. In all cases, the applicant cannot possess or use licensed material until after the facilities are approved, equipment is procured, and the license is issued.

Applicants are reminded that records important to decommissioning are required to be maintained in an identifiable location. For further information, see the section entitled, “Financial Assurance and Record Keeping for Decommissioning.”

Figure 8.3 Typical Facility Diagram.

Response from Applicant: Applicants must provide: Copies of their registration or license from a State Board of Pharmacy as a pharmacy; or evidence that they are operating as a nuclear pharmacy within a Federal medical institution;

Note: There may be jurisdictions that do not recognize the practice of commercial radiopharmacy. In those cases, the applicant must submit evidence that it is registered or licensed with the FDA as a drug manufacturer.

AND

- Description of the facilities and equipment to be made available at each location where radioactive material will be used. A diagram should be submitted showing the applicant’s

entire facility and identify activities conducted in all contiguous areas surrounding the facility (see Figure 8.3, above). Diagrams should be drawn to a specified scale, or dimensions should be indicated.

Include the following information:

- Descriptions of the area(s) assigned for the receipt, storage, preparation, and measurement of radioactive materials and the location(s) for radioactive waste storage;
- Sufficient detail in the diagram to indicate locations of shielding, the proximity of radiation sources to unrestricted areas, and other items related to radiation safety;
- A general description of the ventilation system including representative equipment such as glove boxes or fume hoods. Pertinent airflow rates, differential pressures, filtration equipment, and monitoring systems should be described in terms of the minimum performance to be achieved. Confirm that such systems will be employed for the use or storage of radioactive materials with the probability of becoming airborne, such as compounding radioiodine capsules and dispensing radioiodine solutions; and
- Verification that ventilation systems ensure that effluents are within the dose limits of 10 CFR 20.1301, the ALARA constraints for air emissions established under 10 CFR 20.1101(d), and are ALARA.

8.10 Item 10: Radiation Safety Program

8.10.1 Audit Program

Regulations: 10 CFR 20.1101, 10 CFR 20.2102.

Criteria: Licensees must review the content and implementation of their radiation protection programs annually to ensure the following:

- Compliance with NRC and DOT regulations (as applicable), and the terms and conditions of the license;
- Occupational doses and doses to members of the public are ALARA (10 CFR 20.1101); and
- Records of audits and other reviews of program content are maintained for 3 years.

Discussion: Appendix I contains a suggested audit program that is specific to commercial radiopharmacies and is acceptable to NRC. All areas indicated in Appendix I may not be applicable to every licensee, and all items may not need to be addressed during each audit. For example, licensees do not need to address areas which do not apply to their activities, and activities which have not occurred since the last audit need not be reviewed at the next audit.

Currently, the NRC's emphasis during inspections is to perform actual observations of work in progress. As a part of their audit programs, applicants should consider performing unannounced audits of the radiopharmacy to observe whether radiation safety procedures are being followed, etc.

It is essential that once identified, problems be corrected comprehensively and in a timely manner; Information Notice (IN) 96-28, "Suggested Guidance Relating to Development and

Implementation of Corrective Action,” provides guidance on this subject. The NRC will review the licensee’s audit results and determine if corrective actions are thorough, timely, and sufficient to prevent recurrence. If violations are identified by the licensee and these steps are taken, the NRC can exercise discretion and will normally elect not to cite a violation. The NRC’s goal is to encourage prompt identification and prompt, comprehensive correction of violations and deficiencies. For additional information on NRC’s use of discretion on issuing violations, refer to the current version of NUREG - 1600, “General Statement of Policy and Procedures for NRC Enforcement Actions.”

Licenseses must maintain records of audits and other reviews of program content and implementation for three years from the date of the record. NRC has found audit records that contain the following information to be acceptable: date of audit, name of person(s) who conducted the audit, persons contacted by the auditor(s), areas audited, audit findings, corrective actions, and follow-up.

Response from Applicant: No response is required. The licensee’s program for auditing its radiation safety program will be reviewed during inspection.

References: The current version of NUREG - 1600 is available electronically at <http://www.nrc.gov>. INs are available in the “Reference Library” on NRC’s Home Page at <http://www.nrc.gov>. For hard copies of NUREG - 1600, IN 96-28, and IP 87117, “Radiopharmacy Programs,” see the Notice of Availability (on the inside front cover of this report).

8.10.2 Radiation Monitoring Instruments

Regulations: 10 CFR 20.1501; 10 CFR 32.72(c); 10 CFR 30.33(a)(2); 10 CFR 20.2103(a).

Criteria: Licensees must possess radiation monitoring instruments to evaluate possible radiation hazards that may be present. Instruments used for quantitative radiation measurements must be calibrated periodically for the radiation measured.

Discussion: Licensees must possess calibrated radiation detection/measurement instruments to perform, as necessary, the following:

- Package surveys;
- Personnel and facility contamination measurements;
- Sealed source leak tests;
- Air sampling measurements;
- Bioassay measurements;
- Effluent release measurements; and
- Dose rate surveys

For the purposes of this document, radiation monitoring instruments are defined as any device used to measure the radiological conditions at a licensed facility. Some of the instruments that may be used to perform the above functions include:

- Portable or stationary count rate meters;
- Portable or stationary dose rate or exposure rate meters;
- Single or multichannel analyzers;
- Liquid Scintillation Counters (LSC);
- Gamma counters;
- Proportional counters;
- Solid state detectors; and
- Hand and foot contamination monitors.

Figure 8.5 *Examples of Portable and Stationary Survey Instruments Used by Radiopharmacies.*

The choice of instrument should be appropriate for the type of radiation to be measured and for the type of measurement to be taken (count rate, dose rate, etc.). Radiopharmacies typically use a broad energy range of gamma and beta radiation emitters and need to use radiation detectors appropriate for those energies. Figure 8.5 illustrates some common survey instruments used for contamination surveys. Applicants should discuss the types of instruments to be used for each type of survey to be performed and the availability of a sufficient quantity of these instruments at their facility.

Instrument calibrations may be performed by the pharmacy or by another person specifically authorized by NRC, an Agreement State, or a licensing state to perform that function. If the pharmacy utilizes the services of another person for instrument calibration, the pharmacy should ensure that person has been authorized by either the NRC, an Agreement State, or a licensing State to perform that activity. Appendix J provides information about instrument specifications and model calibration procedures.

Response from Applicant: Provide one of the following:

- A statement that: “We will use equipment that meets the radiation monitoring instrument specifications and implement the model survey meter calibration program published in Appendix J to NUREG - 1556, Vol. 13, ‘Program-Specific Guidance About Radiopharmacy Licenses’ dated September 1999”;

OR

- A statement that: “We will use equipment that meets the radiation monitoring instrument specifications published in Appendix J to NUREG - 1556, Vol. 13, ‘Program-Specific Guidance About Radiopharmacy Licenses’ dated September 1999, and instruments will be calibrated by other persons authorized by the NRC, an Agreement State, or a licensing State to perform that service”;

OR

- A description of alternative minimum equipment to be used for radiation monitoring and/or alternative procedures for the calibration of radiation monitoring equipment.

8.10.3 Material Receipt and Accountability

Regulations: 10 CFR 20.1501(a), 10 CFR 20.2001, 10 CFR 20.1801, 10 CFR 20.1802, 10 CFR 20.1906, 10 CFR 20.2201, 10 CFR 30.41, 10 CFR 30.51.

Criteria: Licensees must ensure the security and accountability of licensed material and must open packages safely.

Discussion: As illustrated in Figure 8.6, licensed materials must be tracked from receipt to disposal in order to ensure accountability, identify when licensed material could be lost, stolen, or misplaced, and ensure that possession limits listed on the license are not exceeded. Licensees exercise control over licensed material accountability by including the following items (as applicable) in their radiation protection program:

- Physical inventories of sealed sources at intervals not to exceed 6 months;
- Ordering and receiving licensed material;
- Package opening;
- Maintaining material inventory within license possession limits;
- Transfer of material, including distribution; and
- Disposal of material.

Licensees are required to develop, implement, and maintain written procedures for safely opening packages in accordance with 10 CFR 20.1906. Some packages may require special procedures that take into consideration the type, quantity, or half-life of the nuclide being delivered.

A model procedure for safely opening packages containing licensed materials is included in Appendix P.

NRC regulations in 10 CFR 20.1906(b) and (c) state the requirements for monitoring packages containing licensed material. These requirements are described in Table 8.1, below.

Table 8.1 Package Monitoring Requirements

| Package | Contents | Survey Type | Survey Time* |
|--|---|----------------------------------|---|
| Labeled (White I, Yellow II, Yellow III) | Gas or Special Form Greater Than Type A | Radiation Level | As soon as practicable, but not later than 3 hours after receipt of package |
| Labeled (White I, Yellow II, Yellow III) | Not Gas Nor Special Form Greater Than Type A | Contamination Radiation Level | As soon as practicable, but not later than 3 hours after receipt of package |

| Package | Contents | Survey Type | Survey Time* |
|--|--|--------------------|---|
| Labeled (White I, Yellow II, Yellow III) | Gas or Special Form Less Than Type A | None | None |
| Labeled (White I, Yellow II, Yellow III) | Not Gas Nor Special Form Less Than Type A | Contamination | As soon as practicable, but not later than 3 hours after receipt of package |
| Not Labeled | Licensed Material | None | None |

| Package | Contents | Survey Type | Survey Time* |
|---|-------------------|----------------------------------|---|
| Damaged | Licensed Material | Contamination Radiation Level | As soon as practicable, but not later than 3 hours after receipt of package |
| * Assumes packages are received during normal working hours. If packages are received outside of normal working hours, the licensee has three hours after the beginning of the next work day to perform the required surveys. | | | |

10 CFR 20.1906(d) requires that the licensee immediately notify the final delivery carrier and NRC Operations Center when removable radioactive surface contamination exceeds the limit of 22 disintegrations per minute per square centimeter (dpm/cm²) averaged over 300 cm²; or external radiation levels exceed 2.0 mSv/hr (200 mrem/hr) at the surface.

Figure 8.6 Accountability. *Licensees must maintain records of receipt, transfer, and disposal of licensed material.*

Licensees must secure and control licensed material and should have a means of promptly detecting losses of licensed material. 10 CFR 20.1801 and 20.1802 require licensees to secure radioactive materials from unauthorized removal or access while in storage and to control and maintain constant surveillance over licensed material that is not in storage.

Licenses will normally contain specific conditions requiring the licensee to perform inventories and leak tests of sealed sources every six months (see sample license in Appendix E). Since the leak tests require an individual to locate and work with the sealed source, records of leak tests may be used as part of an inventory and accountability program. Sources in storage that are used infrequently may not require leak testing; however, the inventory must still be performed at the specified interval.

With regard to unsealed licensed material, licensees use various methods (e.g., computer programs, manual ledgers, log books) to account for receipt, use, transfer, disposal, and radioactive decay. These methods help to ensure that possession limits are not exceeded.

Table 8.2 list the types and retention times for the records of receipt, use, transfer, and disposal (as waste) of all licensed material the applicant must maintain. Other records such as transfer records could be linked to radioactive material inventory records.

Table 8.2 Record Maintenance

| Type of Record | How Long Record Must be Maintained |
|----------------|---|
| Receipt | For as long as the material is possessed until 3 years after transfer or disposal |
| Transfer | For 3 years after transfer |
| Disposal | Until NRC terminates the license |

Important to decommissioning

Until the site is released for unrestricted use

Material accountability records typically contain the following information:

- Radionuclide and activity (in units of becquerels or curies), and date of measurement of byproduct material;
- For each sealed source, manufacturer, model number, location and, if needed for identification, serial number and as appropriate, manufacturer and model number of device containing the sealed source;
- Date of the transfer and name and license number of the recipient, and description of the radioactive material (e.g., radionuclide, activity, manufacturer's name and model number, serial number); and
- For licensed materials disposed of as waste, include the radionuclide, activity, date of disposal, and method of disposal (decay, sewer, etc.).

See the section on "Waste Disposal" for additional information.

Information about locations where licensed material is used or stored are among the records important to decommissioning and required by 10 CFR 30.35(g). See also the section on "Financial Assurance and Record Keeping for Decommissioning."

Response from Applicant: Provide the following statements:

- "We have developed, and will implement and maintain, written procedures for safely opening packages that meet the requirements in 10 CFR 20.1906";

AND

- "We will conduct physical inventories of sealed sources of licensed material at intervals not to exceed 6 months";

AND

- "We have developed, and will implement and maintain written procedures for licensed material accountability and control to ensure that:
 - license possession limits are not exceeded;
 - licensed material in storage is secured from unauthorized access or removal;
 - licensed material not in storage is maintained under constant surveillance and control;and
 - records of receipt, transfer, and disposal of licensed material are maintained."

8.10.4 Occupational Dose

Regulations: 10 CFR 20.1501, 10 CFR 20.1502, 10 CFR 20.1201, 10 CFR 20.1202, 10 CFR 20.1203, 10 CFR 20.1204, 10 CFR 20.1207, 10 CFR 20.1208, 10 CFR 20.2106, 10 CFR 20 Appendix B.

Criteria: Each licensee shall evaluate the potential occupational exposures of all workers and

monitor occupational exposure to radiation when required.

Discussion: The licensee should perform an evaluation of the dose the individual is likely to receive prior to allowing the individual to receive the dose (prospective evaluation). When performing the prospective evaluation, only a dose that could be received at the facilities of the applicant or licensee performing the evaluation needs to be considered. These estimates can be based on any combination of work location radiation monitoring, survey results, monitoring results of individuals in similar work situations, or other estimates to produce a “best estimate” of the actual dose received. For individuals who have received doses at other facilities in the current year, the previous dose need not be considered in the prospective evaluation if monitoring was not required at the other facilities. This evaluation need not be made for every individual; evaluations can be made for employees with similar job functions or work areas. Further guidance on evaluating the need to provide monitoring is provided in Regulatory Guide 8.34, “Monitoring Criteria and Methods to Calculate Occupational Doses, dated July 1992.”

If the prospective evaluation shows that an individual’s dose is not likely to exceed 10% of any applicable regulatory limit, the individual is not required to be monitored for radiation exposure and there are no recordkeeping or reporting requirements for doses received by that individual. If the prospective dose evaluation shows that the individual is likely to exceed 10% of an applicable limit, monitoring is required.

Licensees shall monitor worker exposures for:

Adults who are likely to receive an annual dose in excess of any of the following:

- 5 mSv (0.5 rem) deep-dose equivalent;
- 15 mSv (1.5 rems) eye dose equivalent;
- 50 mSv (5 rems) shallow-dose equivalent to the skin; and
- 50 mSv (5 rems) shallow-dose equivalent to any extremity.

Minors who are likely to receive an annual dose in excess of any of the following:

- 1.0 mSv (0.1 rem) deep-dose equivalent;
- 1.5 mSv (0.15 rem) eye dose equivalent;
- 5 mSv (0.5 rem) shallow-dose equivalent to the skin; and
- 5 mSv (0.5 rem) shallow-dose equivalent to any extremity.

Declared pregnant women who are likely to receive an annual dose from occupational exposures in excess of 1.0 mSv (0.1 rem) deep-dose equivalent, although the dose limit applies to the entire gestation period.

Internal exposure monitoring is required for:

- Adults likely to receive in 1 year an intake in excess of 10% of the applicable ALIs for ingestion and inhalation; and
- Minors and declared pregnant women likely to receive in 1 year a committed effective dose equivalent in excess of 1.0 mSv (0.1 rem).

If an individual is likely to receive in 1 year a dose greater than 10% of any applicable limit (see Figure 8.7 for annual dose limits for adults), monitoring for occupational exposure is required. ANPs and radiopharmacy technologists are generally likely to receive 10% of the limits for occupational dose. Most radiopharmacies provide these employees with whole body and extremity monitors.

Figure 8.7 Annual Dose Limits for Occupationally Exposed Adults.

| |
|---|
| $\text{TOTAL EFFECTIVE DOSE EQUIVALENT (TEDE)} = \text{DEEP DOSE FROM EXTERNAL EXPOSURE} + \text{DOSE FROM INTERNALLY DEPOSITED RADIONUCLIDES}$ |
|---|

Most licensees use either film badges or thermoluminescent dosimeters (TLDs) that are supplied by a NVLAP-approved processor to monitor for external exposure. The exchange frequency for film badges is generally monthly due to technical concerns about film fading. The exchange frequency for TLDs is generally quarterly. Applicants should verify that the processor is NVLAP-approved. Consult the NVLAP-approved processor for its recommendations for exchange frequency and proper use. If monitoring is required, then the licensee must maintain records of the monitoring regardless of the actual dose received.

The types and quantities of radioactive material used at most commercial radiopharmacies provide a reasonable possibility for an internal intake by ANPs and radiopharmacy technologists. Uses such as preparing radioiodine capsules from liquid solutions, and opening and dispensing from vials containing millicurie quantities of radioiodine and other isotopes require particular caution. Precautionary measures for personnel to follow during iodine capsule preparation should involve the use of a fume hood and glove box or shoulder length gloves (see Appendix Q for additional guidance on precautionary measures). To monitor internal exposure from such operations, most pharmacies institute a routine bioassay program to periodically monitor these workers.

A program for performing thyroid uptake bioassay measurements should include adequate equipment to perform bioassay measurements, procedures for calibrating the equipment, including factors necessary to convert counts per minute into becquerel or microcurie units and should address the technical problems commonly associated with performing thyroid bioassays (e.g., statistical accuracy, attenuation by neck tissue). Thyroid bioassay procedures should also specify the interval between bioassays, action levels, and the actions to be taken at those levels. Generally, thyroid uptake bioassay measurements at radiopharmacies are performed weekly for those workers who routinely handle radioiodine or are in the immediate vicinity when radioiodine is being handled. For guidance on developing bioassay programs and determination of internal occupational dose and summation of occupational dose, refer to Regulatory Guide 8.9, Revision 1, Acceptable Concepts, Models, Equations and Assumptions for a Bioassay Program” dated July 1993, Regulatory Guide 8.34, “Monitoring Criteria and Methods to Calculate Occupational Doses,” dated July 1992, and NUREG - 1400, “Air Sampling in the Workplace,” dated September 1993.

Response from Applicant: Submit the following statement: “We have developed and will

implement and maintain written procedures for monitoring occupational dose that meet the requirements in 10 CFR 20.1501, 10 CFR 20.1502, 10 CFR 20.1201, 10 CFR 20.1202, 10 CFR 20.1203, 10 CFR 20.1204, 10 CFR 20.1207, 10 CFR 20.1208, 10 CFR 20.2106, as applicable.”

Note: Some licensees choose to monitor their workers for reasons other than compliance with NRC requirements (e.g., in response to worker requests).

References: National Institute of Standards and Technology (NIST) Publication 810, “National Voluntary Laboratory Accreditation Program Directory,” is published annually and is available electronically at <<http://ts.nist.gov/nvlap>>. NIST Publication 810 can be purchased from GPO, whose URL is <<http://www.gpo.gov>>. ANSI N322 may be ordered electronically at <<http://www.ansi.org>> or by writing to ANSI, 1430 Broadway, New York, NY 10018. See the Notice of Availability (on the inside front cover of this report) to obtain copies of Regulatory Guide 8.7, Revision 1, “Instructions for Recording and Reporting Occupational Radiation Exposure Data,” dated June 1992; Regulatory Guide 8.9, Revision 1, Acceptable Concepts, Models, Equations and Assumptions for a Bioassay Program” dated July 1993; Regulatory Guide 8.34, “Monitoring Criteria and Methods to Calculate Occupational Radiation Doses,” dated July 1992 and NUREG - 1400, “Air Sampling in the Workplace,” dated September 1993.

8.10.5 Public Dose

Regulations: 10 CFR 20.1003, 10 CFR 20.1101(d), 10 CFR 20.1301, 10 CFR 20.1302, 10 CFR 20.1801, 10 CFR 20.1802, 10 CFR 20.2107, 10 CFR 20.2203.

Criteria: Licensees must do the following:

- Ensure that licensed material will be used, transported, stored, and disposed of in such a way that members of the public will not receive more than 1 mSv (100 mrem) (TEDE) in one year from licensed activities;
- Ensure that air emissions of radioactive material to the environment will not result in exposures to individual members of the public in excess of 0.1 mSv (10 mrem) (TEDE) in one year from those emissions;
- Ensure that the dose in any unrestricted area will not exceed 0.02 mSv (2 mrem) in any one hour, from licensed operations; and
- Prevent unauthorized access, removal, or use of licensed material.

Discussion: “Public dose” is defined in 10 CFR Part 20 as “the dose received by a member of the public from exposure to radiation and/or radioactive material released by a licensee, or to any other source of radiation under the control of a licensee.” Public dose excludes doses received from background radiation, sanitary sewerage discharges from licensees, and from medical procedures. Whether the dose to an individual is an occupational dose or a public dose depends on the individual’s assigned duties. It does not depend on the area (restricted, controlled, or unrestricted) the individual is in when the dose is received. For guidance about accepted methodologies for determining dose to members of public, please refer to Appendix K.

There are many possible internal dose pathways that contribute to the TEDE. The TEDE can, however, be broken down into three major dose pathway groups:

1. Airborne radioactive material;
2. Waterborne radioactive material; and
3. External radiation exposure.

The licensee should review these major pathways and decide which are applicable to its operations. The licensee must ensure that the total effective dose equivalent from all exposure pathways arising from licensed activities does not exceed 1.0 mSv (100 mrem) to the maximally exposed member of the public. In addition, the licensee must control air emissions, such that the individual member of the public likely to receive the highest total effective dose equivalent (TEDE) does not exceed the constraint level of 0.1 mSv (10 mrem) per year from those emissions. If exceeded, the licensee must report this, in accordance with 10 CFR 20.2203, and take prompt actions to ensure against recurrence.

Licensees should design a monitoring program to ensure compliance with 10 CFR 20.1101(d) and 20.1302(b). The extent and frequency of monitoring will depend upon each licensee's needs. For additional guidance regarding monitoring of effluents, refer to the section entitled, "Radiation Safety Program - Surveys."

During NRC inspections, licensees must be able to provide documentation demonstrating, by measurement or calculation, that the TEDE to the individual member of the public likely to receive the highest dose from the licensed operation does not exceed the annual limit and the dose constraint. See Appendix K for examples of methods to demonstrate compliance.

Response from Applicant: No response is required from the applicant in a license application, but records demonstrating compliance will be examined during inspection.

8.10.6 Safe Use of Radionuclides and Emergency Procedures

Regulations: 10 CFR 20.1101, 10 CFR 20.1801, 10 CFR 20.1802, 10 CFR 20.2201, 10 CFR 20.2202, 10 CFR 20.2203, 10 CFR 30.34(g), 10 CFR 30.50, 10 CFR 19.11(a)(3).

Criteria: Licensees are required to do the following:

- Keep radiation doses to workers and members of the public ALARA;
- Ensure security of licensed material; and
- Make the required notifications of events to NRC.

Discussion: Licensees are responsible for the security and safe use of all licensed material from the time it arrives at their facility until it is used, transferred, and/or disposed. Licensees should develop written procedures to ensure safe use of licensed material, and the procedures should also include operational and administrative guidelines. The written procedures should provide

reasonable assurance that only appropriately trained personnel will handle and use licensed material without undue hazard to workers or members of the public.

General Safety Procedures

The written procedures should include the following elements:

- Contamination controls;
- Waste disposal practices;
- Personnel and area monitoring (including limits);
- Use of protective clothing and equipment;
- Safe handling of radioactive materials;
- Recording requirements;
- Reporting requirements; and
- Responsibilities.

These procedures should include policies for:

- Frequency of personnel monitoring;
- Performing molybdenum-99 breakthrough measurements on each elution from a generator;
- Use of appropriate shielding (see Figure 8.8);
- Frequent glove changes to minimize exposure to the individual and to avoid spread of contamination in the laboratory; and
- Special procedures for higher risk activities, such as use of radioiodine.

Applicants should also develop radioisotope-specific procedures based on the respective hazards associated with the radioisotopes. General safety guidelines are described in Appendix Q. Applicants should use these guidelines to aid in the development of their own procedures for the safe use of radioisotopes.

Licensees should determine if they have areas that require posting in accordance with 10 CFR 20.1902, unless they meet the exemptions listed in 10 CFR 20.1903. Also, containers of licensed material (including radioactive waste) must be labeled in accordance with 10 CFR 20.1904, unless they meet the exemptions in 10 CFR 20.1905.

Figure 8.8 Use of Appropriate Shielding.

Emergency Procedures

Accidents and emergencies can happen during any operation with radioisotopes, including their receipt, transportation, use, transfer, and disposal. Such incidents can result in contamination or release of material to the environment and unintended radiation exposure to workers and members of the public. In addition, loss or theft of licensed material, and fires involving radioactive material can adversely affect the safety of personnel and members of the public. Applicants should therefore develop and implement procedures to minimize, to the extent practical, the potential impact of these incidents on personnel, members of the public, and the environment.

Applicants should establish written procedures to handle events ranging from a minor spill to a major accident that may require intervention by outside emergency response personnel. These procedures should include provisions for immediate response, after-hours notification, handling of each type of emergency, equipment, and the appropriate roles of staff and the radiation safety officer. In addition, the licensee should develop procedures for routine contacts with its local fire department to inform them of its operations and identify locations of radioactive materials and elevated radiation levels in the event of their response to a fire. Except for minor spills or releases of radioactivity that can be controlled and cleaned up by the user, licensee staff should have a clear understanding of their limitations in an emergency with step-by-step instructions and clear direction of whom to contact. The licensee should establish clear delineations between minor contamination events, minor spills, and major spills and events.

Emergency spill response materials should be strategically placed in well-marked locations for use by all trained staff. All equipment should be periodically inspected for proper operation and replenished as necessary. Appendix Q includes model emergency procedures. Applicants may adopt these procedures or develop their own incorporating the safety features included in these model procedures.

Certain incidents and emergencies require notification of NRC. Appendix T provides a listing of major NRC reporting and notification requirements relevant to commercial radiopharmacies.

Response from Applicant: Submit the following statement:

“We have developed and will implement and maintain written procedures for the safe use of radioactive materials that address:

- Facility and personnel radioactive contamination minimization, detection, and control;
- Performing molybdenum-99 breakthrough measurements on all generator elutions used to prepare radioactive drugs for human medical use; and
- Use of protective clothing and equipment by personnel

that meet the requirements in 10 CFR 20.1101, 10 CFR 20.1801, 10 CFR 20.1802, 10 CFR 30.34(g), and 10 CFR 19.11(a)(3) as applicable”;

AND

“We have developed and will implement and maintain written procedures for identifying and responding to emergencies involving radioactive material, including:

- Lost, stolen, or missing licensed material;
- Exposures to personnel and the public in excess of NRC regulatory limits;
- Releases of licensed materials in effluents and the sanitary sewer in excess of NRC regulatory limits;
- Excessive radiation levels or radioactive material concentrations in restricted or unrestricted areas;
- Radioactive spills and contamination;
- Fires, explosions, and other disasters with the potential for the loss of containment of licensed

- material; and
- Routine contacts with local fire departments

that meet the requirements in 10 CFR 20.1101, 10 CFR 20.2201-2203, and 10 CFR 30.50, as applicable.”

Reference: See the Notice of Availability on the inside front cover of this report to obtain copies of: NUREG - 1460, Revision 1, “Guide to NRC Reporting and Recordkeeping Requirements,” dated July 1994.

8.10.7 Surveys

Regulations: 10 CFR 30.53, 10 CFR 20.1501, 10 CFR 20.2103.

Criteria: Licensees are required to make surveys of potential radiological hazards in their workplace. Records of survey results must be maintained.

Discussion: Surveys are evaluations of radiological conditions and potential hazards (see Figure 8.9). These evaluations may be measurements (e.g., radiation levels measured with survey instrument or results of wipe tests for contamination), calculation, or a combination of measurements and calculations. The selection and proper use of appropriate instruments is one of the most important factors in ensuring that surveys accurately assess the radiological conditions. In order to meet regulatory requirements for surveying, measurements of radioactivity should be understood in terms of its properties (i.e., alpha, beta, gamma) and compared to the appropriate limits.

Figure 8.9 Types of Surveys. *There are many different types of surveys performed by radiopharmacy licensees.*

Radiation surveys are used to detect and evaluate contamination of:

- Facilities (restricted and unrestricted areas);
- Equipment;
- Incoming and outgoing radioactive packages; and
- Personnel (during use, transfer, or disposal of licensed material) (see Figure 8.10).

Surveys are also used to plan work in areas where licensed material or radiation exists and to evaluate doses to workers and individual members of the public.

Figure 8.10 Personnel Surveys. *Users of unsealed licensed material should check themselves for contamination (frisk) before leaving the restricted areas within the radiopharmacy.*

Figure 8.11 Typical Surveys at Radiopharmacy.

Surveys are required when it is reasonable under the circumstances to evaluate a radiological hazard and when necessary for the licensee to comply with the appropriate regulations. Many different types of surveys may need to be performed due to the particular use of licensed

materials. The most important are as follows:

- Surveys for radioactive contamination that could be present on surfaces of floors, walls, laboratory furniture, and equipment;
- Measurements of radioactive material concentrations in air for areas where radiopharmaceuticals are handled or processed in unsealed form and where operations could expose workers to the inhalation of radioactive material (e.g. radioiodine) or where licensed material is or could be released to unrestricted areas;
- Bioassays to determine the kinds, quantities or concentrations, and in some cases, the location of radioactive material in the human body. Radioiodine uptake in a worker's thyroid gland is commonly measured by external counting using a specialized thyroid detection probe;
- Surveys of external radiation exposure levels in both restricted and unrestricted areas; and
- Surveys of radiopharmaceutical packages entering (e.g., from suppliers and returns from customers) and departing (e.g., prepared radiopharmaceuticals for shipment to customers).

The frequency of routine surveys depends on the nature, quantity, and use of radioactive materials, as well as the specific protective facilities, equipment, and procedures that are designed to protect workers from external and internal exposure. Also, the frequency of the survey depends on the type of survey, such as those listed above. Appendix R, "Radiation Surveys," contains a model procedure for radiation survey frequencies.

Not all instruments can measure a given type of radiation (e.g. alpha, beta and gamma). The presence of other radiation may interfere with a detector's ability to measure the radiation of interest. The energy of the radiation may not be high enough to penetrate some detector windows and be counted. The correct selection, calibration and use of radiation detection instruments is an important aspect of any radiation safety program.

10 CFR Part 20 does not specify limits for surface contamination, but it does specify dose limits for unrestricted areas (2 millirem in any one hour) and posting requirements (5 millirem in any one hour for "Radiation Areas"). Each applicant should propose and justify their removable surface contamination and radiation level action limits that will require action to (1) reduce the contamination or radiation level; or (2) institute additional restrictions on access to the area. See Tables R.1 and R. 2 in Appendix R for guidance on surface contamination limits acceptable to the NRC.

Undetected Contamination and Loss of Control of Licensed Material

Due to the large quantities of licensed material in liquid form often handled by radiopharmacy personnel, there can be a greater potential for radioactive material contamination. Radiation surveys, if properly conducted as outlined in this section, will normally detect contamination before it leaves the licensee's restricted area (e.g., radiopharmaceutical preparation and packaging areas). If detected within the restricted area during or shortly following radiopharmaceutical preparation, the licensee can normally complete standard decontamination activities to mitigate the spread of the contamination outside the restricted area.

There have been several instances involving NRC licensees, including radiopharmacies, in which

contamination has not been detected (usually due to no survey being done, or else an inadequate survey being performed) and which is inadvertently removed from the restricted area. Typically the contamination has been deposited on an outgoing package containing radioactive material, the skin or clothing of a licensee employee leaving the facility, or both. Once the contamination leaves the licensee's restricted area, control of the radioactive material is lost. At this point the contamination has a high probability of reaching public locations outside the radiopharmacy including one or more of its customers (e.g., a hospital). Contamination incidents such as this can create public health, regulatory, and public relations problems for licensees. In virtually all cases, the events could have been avoided if licensee personnel had performed an adequate radiation survey to detect the contamination before leaving the restricted area. NRC Information Notice 98-18, "Recent Contamination Incidences Resulting From Failure to Perform Adequate Surveys," dated May 13, 1998, describes some such incidents involving NRC licensees followed by a summary of the NRC requirements to perform adequate and timely surveys.

Response from Applicant: Submit the following statement: "We have developed and will implement and maintain written procedures for a survey program that specifies the performance of radiation and contamination level surveys in restricted and unrestricted areas, personnel contamination monitoring, action levels, and the frequencies and records maintenance of those surveys and monitoring that meet the requirements in 10 CFR 30.53, 10 CFR 20.1501, and 10 CFR 20.2103, as applicable."

References: See the Notice of Availability on the inside front cover of this report to obtain copies of NRC Information Notice 98-18, "Recent Contamination Incidences Resulting From Failure to Perform Adequate Surveys," dated May

8.10.8 Dosage Measurement Systems 13, 1998.

Regulations: 10 CFR 32.72(c).

Criteria: Commercial radiopharmacy licensees must possess and use instrumentation capable of accurately measuring the radioactivity in radioactive drugs.

Discussion: Due to the potential for radiopharmacy errors to adversely affect their customers (medical facilities) and their customers' patients, each dosage of a radioactive drug must be measured prior to transfer to provide high confidence that the correct amount of the radioactive drug is transferred in accordance with the customer's request.

The applicant must have procedures for the use of the instrumentation, including the measurement, by direct measurement or by combination of measurement and calculation, of the amount of radioactivity in dosages of alpha-, beta-, or photon-emitting radioactive drugs prior to their transfer for commercial distribution.

These procedures must ensure that the dose calibrator, or other dose measurement system, functions properly. This is accomplished by performing periodic checks and tests prior to first use, followed by checks at specified intervals, and following repairs that could affect system

performance. Equipment used to measure dosages that emit gamma, alpha, or beta radiation must be calibrated for the applicable radionuclide being measured. Currently, no alpha-emitting nuclides are used in unsealed form in medicine; therefore, guidance is not provided in this document on the measurement of these radionuclides. For photon-emitters, activity measurement is a fairly straightforward determination; however, for beta-emitters, a correction factor is often necessary to accurately determine the activity. There are inherent technical difficulties to overcome in the determination and application of beta-correction factors. These difficulties include dependence on geometry, lack of an industry standard for materials used in the manufacture of both vials and syringes, and lack of a National Institute of Standards and Technology (NIST) traceable standard for all radionuclides currently in use. If radiopharmacies intend to **initially** distribute, i.e., measure, prepare, and label, beta-emitting radionuclides, the applicant must provide the calculation to demonstrate its ability to accurately dispense such materials. If the applicant intends to use beta-correction factors supplied by the instrument manufacturer, or other entity, it should include a means for ensuring the accuracy of the supplied factor. If radiopharmacy applicants intend to only redistribute beta-emitting radionuclides that have been previously prepared and distributed by other persons licensed pursuant to 10 CFR 32.72, then the correction factor calculation is not required.

Licensees must assay patient dosages in the same type of vial and geometry as used to determine the correct dose calibrator settings. The use of different vials or syringes may result in measurement errors, for example, due to the variation of bremsstrahlung created by interaction between beta particles and the differing dosage containers. Licensees are reminded that beta emitters should be shielded using a low-atomic-numbered material to minimize the production of bremsstrahlung, followed by a high-atomic-numbered material thick enough to attenuate the bremsstrahlung intensity.

For each dose measurement system, specific periodic tests must be performed, as appropriate to the system, to ensure correct operation. Typically, all systems must be checked each day of use for constancy to ensure continued proper operation of the system. In addition, other appropriate tests may include accuracy (for the range of energies to be measured), linearity (for the range of activities to be measured), and geometry dependence (for the range of volumes and product containers).

The applicant should ensure that it possesses a sufficient number of such instruments to allow for periods when instruments are out of service for repair and calibration.

Appendix O contains a model procedure for dose calibrator testing.

Response from Applicant: The applicant shall describe the types of systems (measurement or combination of measurement and calculation) it intends to use for the measurement of alpha-, beta-, and photon-emitting radioactive drugs;

AND

For each dose measurement system used to measure the amount of radioactivity in alpha-, beta-,

or photon-emitting radioactive drugs, state: “We have developed, and will implement and maintain a written procedure for the performance of dose measurement system checks and tests that meets the requirements in 10 CFR 32.72(c)”;

AND

If applicable, the applicant must include a sample calculation for determining beta-correction factors for dose calibrators with ionization chambers;

Radiopharmacies that intend to initially distribute (i.e., measure, prepare, and label) beta-emitting radionuclides must provide the calculation to demonstrate its ability to accurately dispense such materials; however, a correction factor calculation is not required if radiopharmacy applicants intend to only redistribute beta-emitting radionuclides that were previously prepared and distributed by others who are licensed pursuant to 10 CFR 32.72.

OR

If applicable, the applicant must include a means for ensuring the accuracy of beta-correction factors supplied by the instrument manufacturer, or other entity.

8.10.9 Transportation

Regulations: 10 CFR 71.5, 10 CFR 71.12, 10 CFR 71.13, 10 CFR 71.14, 10 CFR 71.47, 10 CFR 71.87, 49 CFR Parts 171-178, 10 CFR 20.1101, 10 CFR 30.41, 10 CFR 30.51.

Criteria: Applicants who will prepare for shipment, ship, or transport radioactive materials, including radioactive waste, must develop, implement, and maintain safety programs for the transport of those materials to ensure compliance with NRC and U.S. Department of Transportation (DOT) regulations.

Discussion: In accordance with a Memorandum of Understanding between the DOT and NRC, the NRC inspects and enforces DOT’s regulations governing the transport of radioactive materials by the NRC’s licensees.

The types and quantities of radioactive materials shipped by commercial radiopharmacy licensees will nearly always meet the criteria for shipment in a “Type A” package, as defined by the DOT. The requirements for these packages include the provisions for shipping papers, packaging design standards, package marking and labeling, and radiation and contamination level limits. For radiopharmacies who transport their own packages, the packages must be blocked and braced, and shipping papers must be used and located properly in the driver’s compartment.

Packaging used by commercial radiopharmacies typically includes military ammunition boxes, “briefcases,” and cardboard/fiberboard boxes. These packages will normally meet the criteria for “Type A” quantities, which must meet specified performance standards to demonstrate that they will maintain the integrity of containment and shielding under normal conditions of transport.

Such packages will normally withstand minor accident situations and rough handling conditions. The testing criteria for Type A packages are listed in 49 CFR 173.465. Before offering a Type A package for shipment, the shipper is responsible for ensuring that the package has been tested to meet the criteria for the contents and the configuration to be shipped and maintaining a certificate of testing. Shippers are not required to personally test the packages, but must ensure that the testing was performed before use and maintain a record of the testing.

DOT regulations also require that individuals who perform functions related to the packaging and shipment of radioactive material packages receive training specific to those functions. The training must include a general awareness of DOT requirements, function-specific training for the individuals' duties, and safety training. DOT also specifies the frequency of the training and a record retention requirement for training (see section 8.8.2).

An outline of DOT and NRC requirements generally relevant to commercial radiopharmacy operations is included for applicant and licensee reference in Appendix M.

Response from Applicant: No response is required. The licensee's program for transportation of radioactive materials will be reviewed during inspection.

References: "A Review of Department of Transportation Regulations for Transportation of Radioactive Materials," can be obtained by calling DOT's Office of Hazardous Material Initiatives and Training at (202) 366-4425. The Memorandum of Understanding with DOT on the Transportation of Radioactive Material, signed June 6, 1979, is available from NRC upon request.

8.10.10 Minimization of Contamination

Regulations: 10 CFR 20.1406.

Criteria: Applicants for new licenses must describe how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

Discussion: All applicants for new licenses need to consider the importance of designing and operating their facilities to minimize the amount of radioactive contamination generated at the site during its operating lifetime and to minimize the generation of radioactive waste during decontamination. In the case of commercial radiopharmacy applicants, these issues usually do not need to be addressed as a separate item, as they are included in responses to other items of the application.

The bulk of unsealed radioactive material utilized by radiopharmacies have short half-lives (under 120 days). These radionuclides do not pose a source of long-term contamination. Additionally, nearly all radioactive waste generated by radiopharmacies is stored for decay rather than transferred to a radioactive waste disposal facility.

The licensee may possess and redistribute sealed sources that contain radionuclides with long half lives. These sealed sources have been approved by NRC or an Agreement State and, if used according to the respective SS&D Registration Certificate, usually pose little risk of contamination. Leak tests performed at the frequency specified in the SS&D Registration Certificate should identify defective sources. Leaking sources must be immediately withdrawn from use and decontaminated, repaired, or disposed of according to NRC requirements. These steps minimize the spread of contamination and reduce radioactive waste associated with decontamination efforts.

Response from Applicant: The applicant does not need to provide a response to this item under the following condition. NRC will consider that the above criteria have been met if the applicant's responses meet the criteria in the following sections: Facilities and Equipment; Radiation Safety Program - Safe Use of Radionuclides and Emergency Procedures; Radiation Safety Program - Surveys; Radiation Safety Program - Leak Testing; and Waste Management, of NUREG - 1556, Vol. 13, "Consolidated Guidance About Materials Licenses, Program Specific Guidance About Commercial Radiopharmacies," dated September 1999.

8.10.11 Radioactive Drug Labeling for Distribution

Regulations: 10 CFR 20.1901; 10 CFR 20.1904; 10 CFR 20.1905; 10 CFR 30.34(g); and 10 CFR 32.72(a)(4).

Criteria: The labels affixed to radioactive drugs for distribution must have the required color, symbol, and wording.

Discussion: The licensee must label each "transport radiation shield" to show the radiation symbol as described in 10 CFR 20.1901. The label must also include the words "CAUTION, RADIOACTIVE MATERIAL" OR "DANGER, RADIOACTIVE MATERIAL," the name of the radioactive drug or its abbreviation, and the quantity of radioactivity at a specified date and time. The phrase "transport radiation shield" refers to the primary shield for the radioactive drug, which may include the syringe, vial, or syringe or vial shield. The "transport radiation shield" should be constructed of material appropriate for the isotope to be transferred for commercial distribution. The "transport radiation shield" does not refer to the outer suitcase, packaging, or other carrying device, even though that barrier may provide some radiation shielding.

The licensee must label each syringe, vial, or other container (e.g., generator or ampule) used to hold radioactive drugs to be transferred for commercial distribution to show the radiation symbol, as described in 10 CFR 20.1901. The label must include the words "CAUTION, RADIOACTIVE MATERIAL" OR "DANGER, RADIOACTIVE MATERIAL," and an identifier that ensures the syringe, vial, or other container can be correlated with the information on the "transport radiation shield" label. The identifier must provide a correlation between the syringe, vial, or other container and the information on the label of its "transport radiation shield." Identifiers may include the prescription number, the name of the radioactive drug or its abbreviation, the name of the patient, or the clinical procedure.

Applicants Response: The applicant must:

- Describe all labels, indicating the colors to be used, that will accompany the products and describe where each label is placed (e.g., on the “transport radiation shield” or the container used to hold the radioactive drug); and
- Agree to affix the required labels to all “transport radiation shields” and each container used to hold the radioactive drugs.

8.10.12 Radioactive Drug Shielding for Distribution

Regulations: 10 CFR 32.72(a)(3); 10 CFR 20.1201; 10 CFR 20.1207; 10 CFR 20.1208.

Criteria: The shielding provided for each radioactive drug to be distributed must be adequate for safe handling and storage by the pharmacy’s customers to maintain occupational exposures ALARA.

Discussion: The applicant must provide appropriate “transport radiation shields” for the primary container of each radioactive drug that it intends to distribute. The shielding must be adequate for the types and quantities of radioactive materials that the applicant intends to distribute. Typically, “transport radiation shields” used by radiopharmacies have included two-piece, shielded syringe and vial containers (or “pigs”). Pharmacies have used lead and tungsten shields for gamma-emitting materials and plexiglass inserts for beta-emitters.

As general guidelines, “transport radiation shields” for technetium-99m products have ensured surface radiation levels of not more than 0.03 milliSievert per hour (mSv/hr) (3 mrem/hr), due to the ease of shielding the low energy gamma emitted. For iodine-131, surface dose rates on “transport radiation shields” have been approved up to 0.5 mSv/hr (50 mrem/hr) for diagnostic dosages and up to 1.5 mSv/hr (150 mrem/hr) for therapeutic dosages. The applicant should select appropriate shielding materials and dimensions to not only ensure that occupational doses are ALARA, but also that the “transport radiation shield” can be easily handled.

Applicants Response: For each radioactive drug to be distributed (except for products intended for redistribution without manipulation and in the manufacturer’s original shipping package):

- Indicate the radionuclide and the maximum activity for each type of container (e.g., vial, syringe);
- Describe the type and thickness of the “transport radiation shield” provided for each type of container; and
- Indicate the maximum radiation level to be expected at the surface of each “transport radiation shield” when the radioactive drug container is filled with the maximum activity.

Note: It is not acceptable to state that the applicant will comply with DOT regulations. The dose rate limits that DOT imposes apply to the surface of the package, not the surface of the “transport radiation shield.”

8.10.13 Leak Tests

Regulations: 10 CFR 30.53, 10 CFR 20.1501, 10 CFR 20.2103.

Criteria: NRC requires testing to determine whether there is any radioactive leakage from the sealed sources. Records of the test results must be maintained.

Discussion: When issued, a license will require performance of leak tests at intervals approved by the NRC or an Agreement State and specified in the SSD Registration Certificate. The measurement of the leak test sample is a quantitative analysis requiring that instrumentation used to analyze the sample be capable of detecting 185 Bq (0.005 microcuries) of radioactivity.

Commercial radiopharmacies may have their sealed sources leak tested by an individual licensed by the NRC or an Agreement State to perform leak testing, or radiopharmacies may perform leak testing of their own sealed sources. Appendix L contains a model procedure for performance of leak testing and sample analysis. If the radiopharmacy has its leak testing performed by a licensed leak test provider, the radiopharmacy is expected to take the leak test samples according to the sealed source manufacturer's and the leak test provider's kit instructions and return it to the provider for evaluation and reporting results. Leak test samples should be collected at the most accessible area where contamination would accumulate if the sealed source were leaking.

Some radiopharmacies have been authorized to perform leak testing as a service for other licensees (customers). The subsection titled "service activities" addresses requests to perform leak testing as a service for other licensees.

Response from Applicant: Submit the following statement: "We have developed and will implement and maintain written procedures for leak testing that meet the requirements in 10 CFR 30.53, 10 CFR 20.1501, and 10 CFR 20.2103."

Note: Leak testing is authorized via a license condition.

Applicants must specifically request authorization to perform leak testing as a service to other licensees. Requests to provide leak testing as a service to other licensees will be reviewed and, if approved, NRC staff will authorize via a license condition.

8.11 Item 11: Waste Management

Regulations: 10 CFR 20.2001(a), 10 CFR 20.2003, 10 CFR 20.2006, 10 CFR 20.1904(b), 10 CFR 20.2108, 10 CFR 30.51.

Criteria: Radioactive waste must be disposed of in accordance with regulatory requirements and license conditions. Appropriate records of waste disposal must be maintained.

Discussion: Radioactive waste is normally generated when conducting licensed activities. Such waste may include used or unused radioactive material, unusable items contaminated with radioactive material, e.g., absorbent paper, gloves, etc. Licensees may not receive radioactive

waste from other licensees for processing, storage or disposal, unless specifically authorized to do so by NRC. Commercial radiopharmacies may request to receive certain radioactive waste returned from their customers. For guidance on receiving radioactive waste from customers, refer to the section titled, "Radiation Safety Program - Waste Management, Returned Wastes from Customers."

All radioactive waste must be stored in appropriate containers until its disposal and the integrity of the waste containers must be assured. Radioactive waste containers must be appropriately labeled. All radioactive waste must be secured against unauthorized access or removal. NRC requires commercial radiopharmacy licensees to manage radioactive waste generated at their facilities by one or more of the following methods:

- Decay-in-Storage (DIS);
- Transfer to an authorized recipient; and
- Release into sanitary sewerage.

Licensees may choose any one or more of these methods to dispose of their radioactive waste. It has been NRC's experience that most commercial radiopharmacies dispose of radioactive waste by decay-in-storage because the majority of licensed materials used by these facilities have short half-lives.

Applicant's programs for management and disposal of radioactive waste should include procedures for handling of waste, safe and secure storage, characterization, minimization, and disposal of radioactive waste. Appropriate training should be provided to waste handlers. Regulations require that licensees maintain all appropriate records of disposal of radioactive waste.

Disposal By Decay-in-Storage (DIS)

NRC permits licensed materials with half-lives of less than or equal to 120 days to be disposed by DIS. The minimum holding period for decay is ten half-lives of the longest-lived radioisotope in the waste. Applicants should assure that adequate space and facilities are available for the storage of such waste. Procedures for management of waste by DIS should include methods of segregation, surveys prior to disposal, and maintenance of records of disposal.

Licensees can minimize the need for storage space, if radioactive waste is segregated according to physical half-life. Segregation of waste is accomplished by depositing radioisotopes of shorter physical half-lives in containers separate from those used to store radioactive waste with longer physical half-lives. Radioactive waste with shorter half-lives will take less time to decay and thus may be disposed in shorter periods of time, freeing storage space.

Used syringes/needles and vials returned from pharmacy customers (medical facilities) are considered both biohazardous and radioactive waste since these items may be contaminated with customer's patients' blood or other body fluids. Following completion of decay-in-storage, such waste may be disposed of as biohazardous waste (medical waste) if radiation surveys (performed in a low background area and without any interposed shielding) of the waste at the end of the

holding period indicate that radiation levels are indistinguishable from background.

Radioactive material labels on the used syringes/needles cannot be defaced without exposing employees to the risk of injury from the needles. Additionally, exposing employees to the risk of injury from needles would place licensees in violation of the Occupational Safety and Health Administration regulations in 29 CFR 1910.1030(d)(1), which requires precautions to prevent contact with blood or other potentially infectious materials, including recommendations not to manipulate used syringes/needles by hand. Thus, radiopharmacy licensee's do not have to deface or remove radiation labels from individual containers and packages (e.g., syringes, vials) inside waste barrels/containers intended for disposal as medical waste, provided the following conditions are met:

- The radioactive material labels on the outer waste barrels/containers will be defaced or removed prior to transfer to waste disposal firm;
- Waste barrels are sealed prior to delivery to the waste disposal firm;
- Waste barrels/containers will be delivered directly from the licensee's facility to a waste disposal firm for disposal;
- Medical waste is incinerated, and not sent to a medical waste landfill; and
- The waste disposal firm is notified that the barrels must not be opened at any point, and for any reason, prior to incineration.

Other pharmacy radioactive waste that has not been returned from customers and has not otherwise come into contact with blood or body fluids should not have a biohazardous component. Following completion of decay-in-storage and provided it has been stored separate from radioactive, biohazardous waste and contains no other hazardous components (e.g. needles, hazardous chemicals), such waste may require disposal as ordinary trash if radiation surveys (performed in a low background area and without any interposed shielding) of the waste at the end of the holding period indicate that radiation levels are indistinguishable from background. All radiation labels must be defaced or removed from containers and packages prior to final disposal as ordinary trash. If the decayed waste is compacted, all labels that are visible in the compacted mass must also be defaced or removed.

Records of DIS should include the date when the waste was put in storage for decay, date when ten half-lives of the longest-lived radioisotope have transpired, date of disposal, results of final survey before disposal as ordinary trash and results of the background survey, identification of the instrument used to perform the survey and the signature or initials of the individual performing the survey.

Transfer to an Authorized Recipient

Licensees may transfer radioactive waste to an authorized recipient for disposal. It has been NRC's experience that most commercial radiopharmacies only dispose of radioactive wastes with half-lives greater than 120 days to authorized recipients (e.g., low-level radioactive waste disposal facilities). Since radiopharmacy licensees typically possess small quantities of these materials, the volume of materials disposed in this manner would also be minimal, if any. Currently, radiopharmacies use this system for waste disposal infrequently; therefore, detailed

guidance is not provided in this document on the specific requirements related to the transfer of wastes to authorized recipients for disposal.

Because of the difficulties and costs associated with disposal of sealed sources, applicants should preplan the disposal. Applicants may want to consider contractual arrangements with the source supplier as part of a purchase agreement.

Release Into Sanitary Sewerage

Licenses may dispose of radioactive waste by release into sanitary sewerage if each of the following conditions are met:

- Material is readily soluble (or is easily dispersible biological material) in water;
- Quantity of licensed material that the licensee releases into the sewer each month averaged over the monthly volume of water released into the sewer does not exceed the concentration specified in 10 CFR Part 20, Appendix B, Table 3;
- If more than one radioisotope is released, the sum of the ratios of the average monthly discharge of a radioisotope to the corresponding limit in 10 CFR Part 20, Appendix B, Table 3 cannot exceed unity; and
- Total quantity of licensed material released into the sanitary sewerage system in a year does not exceed the limits specified in 10 CFR 20.2003(a)(4).

Licenses are responsible for demonstrating that licensed materials discharged into the sewerage system are indeed readily dispersible in water. NRC IN 94-07, "Solubility Criteria for Liquid Effluent Releases to Sanitary Sewerage Under the Revised 10 CFR Part 20," dated January 1994, provides the criteria for evaluating solubility of liquid waste.

Applicants should develop and implement procedures to ensure that all releases of radioactive waste into the sanitary sewerage, if any, meet the criteria stated in 10 CFR 20.2003. Licenses are required to maintain accurate records of all releases of licensed material into the sanitary sewerage.

Response from Applicant: Submit the following statement: "We have developed and will implement and maintain written procedures for waste management that meet the requirements in 10 CFR 20.1904(b), 10 CFR 20.2001(a), 10 CFR 20.2003, 10 CFR 20.2006, 10 CFR 20.2108, 10 CFR 30.51, as applicable."

Note: Decay-in-storage is authorized via a license condition.

References: See the Notice of Availability on the inside front cover of this report to obtain copies of Policy and Guidance Directive PG 94-05, "Updated Guidance on Decay-In-Storage," dated October 1994; Information Notice 94-07, "Solubility Criteria for Liquid Effluent Releases to Sanitary Sewerage Under the Revised 10 CFR 20," dated January 1994; and Information Notice 84-94, "Reconcentration of Radionuclides Involving Discharges into Sanitary Sewerage Systems Permitted Under 10 CFR 20.203 (now 10 CFR 20.2003)," dated December 1984.

Information Notices are available at <<http://www.nrc.gov>>.

8.11.1 Returned Wastes from Customers

Regulations: 10 CFR 20.2001(a), 10 CFR 30.33, 10 CFR 71.5.

Criteria: Commercial radiopharmacies may receive radioactive waste from customers. This radioactive waste is limited to items that originated at the radiopharmacy and that contained (or contain) radioactive material delivered for customer use (e.g., pharmacy supplied syringes and vials and their contents).

Discussion: Commercial radiopharmacy licenses contain a license condition that permits radioactive waste, consisting of pharmacy supplied items, to be received from their customers. The customer may return, and the radiopharmacy may accept for disposal, only items originating at the radiopharmacy that contained or contain radioactive material. This is limited to pharmacy-supplied syringes and vials and their contents. It is *not* acceptable for customers to return items originating at their facilities that are contaminated with radioactive material supplied by the pharmacy (e.g., gloves, absorbent material, IV tubing, patient contaminated items). If an applicant wishes a broader authorization for radioactive waste retrieval, the applicant must apply for a separate license as a radioactive waste broker under the general provisions of 10 CFR 20.2001(b) and 10 CFR 30.33.

Figure 8.12 Returned Waste. *Only items that originated at the radiopharmacy (pharmacy supplied syringes and vials and their contents) may be returned to the radiopharmacy for disposal.*

Radiopharmacy customers, who act as the shipper for returned materials, should be supplied with detailed written instructions on how to properly prepare and package radioactive waste for return to the radiopharmacy. These instructions should clearly indicate that only items that contained or contain radioactive materials supplied by the radiopharmacy may be returned. In addition, these instructions should be adequate to ensure that customers comply with Department of Transportation (DOT) and NRC regulations for the packaging and transport of licensed materials and for the radiation safety of drivers/couriers. Since customers may return unused syringes and vials, which may contain significant quantities of licensed material, the radiopharmacy should also include in their instructions methods for determining that the activities of radioisotopes returned to the pharmacy are “limited quantities,” or otherwise ensure that customers prepare and offer packages for transport that meet NRC and DOT requirements if the packages contain greater than limited quantities of radioactive material. The radiopharmacy should also have written instructions for pharmacy staff to address pick-up, receipt and disposal of the returnable radioactive waste. Appendix S contains a model procedure for return of pharmacy radioactive wastes from customers.

If the pharmacy chooses to take the responsibility to act as the shipper for returned materials, the pharmacy must ensure that its customer follows DOT and NRC regulations for the packaging and transport of licensed materials and for the radiation safety of drivers/couriers in the return

process.

Response from Applicant: Submit the following statement: “We have developed and will implement and maintain written procedures for customer return of pharmacy supplied syringes and vials and their contents, to specify that:

- Only pharmacy supplied syringes and vials and their contents may be returned to the pharmacy;
- Instructions will be provided to radiopharmacy customers for the proper preparation and packaging of the radioactive waste for return to the radiopharmacy; and
- Instructions will be provided to pharmacy staff for the pick-up, receipt, and disposal of the returned radioactive waste that meet the requirements in 10 CFR 20.2001(a), 10 CFR 30.33, 10 CFR 71.5, as applicable.”

Note: Retrieval, receipt and disposal of pharmacy supplied syringes and vials from customers is authorized via a license condition.

8.12 Item 12: Fees

The next two items on NRC Form 313 are to be completed on the form itself.

On NRC Form 313, enter the appropriate fee category from 10 CFR 170.31 and the amount of the fee enclosed with the application.

Direct all questions about NRC’s fees or completion of Item 12 of NRC Form 313 (Appendix A) to the Office of the Chief Financial Officer at NRC headquarters in Rockville, Maryland, (301) 415-7554. You may also call NRC’s toll free number, (800) 368-5642 and then ask for extension 415-7554.

8.13 Item 13: Certification

Individuals acting in a private capacity are required to date and sign NRC Form 313. Otherwise, representatives of the corporation or legal entity filing the application should date and sign NRC Form 313. Representatives signing an application must be authorized to make binding commitments and to sign official documents on behalf of the applicant. As discussed previously in “Management Responsibility,” signing the application acknowledges management’s commitment and responsibilities for the radiation protection program. NRC will return all unsigned applications for proper signature.

Note:

- It is a criminal offense to make a willful false statement or representation on applications or correspondence (18 U.S.C. 1001).
- When the application references commitments, those items become part of the licensing conditions and regulatory requirements.

9 Amendments and Renewals to a License

It is the licensee's obligation to keep the license current. If any of the information provided in the original application is to be modified or changed, the licensee must submit an application for a license amendment before the change takes place; however, in accordance with 10 CFR 32.72(b)(5), commercial radiopharmacy licensees may allow individuals not named on their licenses to work as ANPs, provided that the individuals meet the minimum training and experience requirements of 10 CFR 32.72(b)(2) or (4), and the licensee notifies the NRC in writing, with the documentation specified in 10 CFR 32.72(b)(5), as applicable, no later than 30 days after the licensee allows the individual to work as an ANP. Also, to continue the license after its expiration date, the licensee must submit an application for a license renewal at least 30 days before the expiration date (10 CFR 2.109, 10 CFR 30.36(a)).

Applications for license amendment or renewal must do the following:

- Be sure to use the most recent guidance in preparing an amendment or renewal request;
- Submit in duplicate, either an NRC Form 313 or a letter requesting amendment or renewal;
- Provide the license number;
- For renewals, provide a complete and up-to-date application if many outdated documents are referenced or there have been significant changes in regulatory requirements, NRC's guidance, the licensee's organization, or radiation protection program. Alternatively, describe clearly the exact nature of the changes, additions, and deletions;
- If a renewal is requested, provide the appropriate fee.

Using the suggested wording of responses and committing to using the model procedures in this report will expedite NRC's review.

10 Applications for Exemptions

Regulations: 10 CFR 19.31; 10 CFR 20.2301, 10 CFR 30.11.

Criteria: Licensees may request exemptions to regulations. The licensee must demonstrate that the exemption is authorized by law, will not endanger life or property or the common defense and security, and is otherwise in the public interest.

Discussion: Various sections of NRC's regulations address requests for exemptions (e.g., 10 CFR 19.31, 10 CFR 20.2301, 10 CFR 30.11(a)). These regulations state that NRC may grant an exemption, acting on its own initiative or on an application from an interested person.

Exemptions are not intended to revise regulations, are not intended for large classes of license, and are generally limited to unique situations. Exemption requests must be accompanied by descriptions of the following:

- Exemption and justification why it is needed;

- Proposed compensatory safety measures intended to provide a level of health and safety equivalent to the regulation for which the exemption is being requested; and
- Alternative methods for complying with the regulation and why compliance with the existing regulation is not feasible.

Until NRC has granted an exemption in writing, NRC expects strict compliance with all applicable regulations.

11 Termination of Activities

Regulations: 10 CFR 30.34(b), 10 CFR 30.35(g), 10 CFR 30.36(d), 10 CFR 30.36(g), 10 CFR 30.36(h), 10 CFR 30.36(j), 10 CFR 30.51(f).

Criteria: The licensee must do the following:

- Notify NRC, in writing, within 60 days of:
 - the expiration of its license;
 - a decision to cease licensed activities permanently at the entire site (regardless of contamination levels);
 - a decision to cease licensed activities permanently in any separate building or outdoor area, if they contain residual radioactivity making them unsuitable for release according to NRC requirements;
 - no principal activities having been conducted at the entire site under the license for a period of 24 months; and
 - no principal activities having been conducted for a period of 24 months in any separate building or outdoor area, if they contain residual radioactivity making them unsuitable for release according to NRC requirements;
- Submit a decommissioning plan, if required by 10 CFR 30.36(g);
- Conduct decommissioning, as required by 10 CFR 30.36(h) and 10 CFR 30.36(j);
- Submit, to the appropriate NRC regional office, completed NRC Form 314, "Certificate of Disposition of Materials" (or equivalent information) and a demonstration that the premises are suitable for release for unrestricted use (e.g., results of final survey); and
- Before a license is terminated, send the records important to decommissioning to the appropriate NRC regional office. If licensed activities are transferred or assigned in accordance with 10 CFR 30.34(b), transfer records important to decommissioning to the new licensee.

Discussion: As noted in several instances discussed in "Criteria," before a licensee can decide whether it must notify NRC, the licensee must determine whether residual radioactivity is present and, if so, whether the levels make the building or outdoor area unsuitable for release, according to NRC requirements. A licensee's determination that a facility is not contaminated is subject to verification by NRC inspection.

For guidance on the disposition of licensed material, see Section 8.11 on "Waste Management."

For guidance on decommissioning records, see Section 8.5.2 on “Radioactive Materials - Financial Assurance and Record Keeping for Decommissioning.”

Response from Applicant: The applicant’s obligations in this matter begin when the license expires or at the time the licensee ceases operations, whichever is earlier. These obligations are to undertake the necessary decommissioning activities, to submit NRC Form 314 or equivalent information, and to perform any other actions as summarized in the Criteria. The applicant is not required to submit a response to the NRC during the initial application.

Reference: Copies of NRC Form 314, “Certificate of Disposition of Materials,” are available upon request from NRC’s Regional Offices (see Figure 2.1 for addresses and telephone numbers).

Appendix A: United States Nuclear Regulatory Commission Form 313

| Form 313 - Sample Application for Material License | |
|---|--|
| Page | Title |
| 1 of 1 | <u>Application for Material License</u> |

Appendix B: List of Documents Considered in Development of This NUREG

This report incorporates and updates the guidance previously found in the NUREG reports, Regulatory Guides (RGs), Policy and Guidance Directives (P&GDs), and Information Notices (INs) listed below. Other NRC documents, such as Manual Chapters (MCs), Inspection Procedures (IPs), and Memoranda of Understanding (MOU) were also consulted during the preparation of this report. *The documents marked with an asterisk (*) have been superseded and should not be used.*

Table A.1 List of NUREG Reports, Regulatory Guides, and Policy and Guidance Directives

| Document Identification | Title | Date |
|-------------------------|---|-------|
| Draft RG DG-0006* | Guide for the Preparation of Applications for Commercial Nuclear Pharmacy Licenses | 3/97 |
| FC 410-4* | Guide for the Preparation of Applications for Nuclear Pharmacy Licenses | 8/85 |
| SRP 85-14* | Standard Review Plan for Applications for Nuclear Pharmacy Licenses | 8/85 |
| P&GD FC 86-9* | Authorizing Possession and Use of Depleted Uranium as Shielding for High Activity Molybdenum-99/Technetium-99m Generators | 6/86 |
| IN 89-25, Rev. 1 | Unauthorized Transfer of Ownership or Control of Licensed Activities | 12/94 |
| IN 97-03 | Defacing of Labels to Comply with 10 CFR 20.1904(b) | 2/97 |
| IN 98-18 | Recent Contamination Incidences Resulting from Failure to Perform Adequate Surveys | 5/98 |
| GL 95-09 | Monitoring and Training of Shippers and Carriers of Radioactive Materials | 11/95 |

Appendix C: Suggested Format for Providing Information Requested in Items 5 through 11 of NRC Form 313

| Item No. | Title and Criteria | Yes | Description Attached |
|-----------|--|-----|----------------------|
| 5. | RADIOACTIVE MATERIAL | | |
| | Sealed And/Or Unsealed Byproduct Material | | |
| | For unsealed materials: | | |
| | <ul style="list-style-type: none"> • Identify each radionuclide (element name and mass number) that will be used, the form, and the maximum requested possession limit. | [] | [] |
| | AND | | |
| | For potentially volatile materials (e.g., iodine-131): | | |
| | <ul style="list-style-type: none"> • Specify whether the material will be manipulated at the radiopharmacy: | [] | N/A |
| | For sealed materials: | | |
| | <ul style="list-style-type: none"> • Identify each radionuclide (element name and mass number) that will be used in each source; | | [] |
| | <ul style="list-style-type: none"> • Provide the manufacturer's (distributor's) name and model number for each sealed source and device requested; | | [] |

| Item No. | Title and Criteria | Yes | Description Attached |
|-----------|--|-----|----------------------|
| | <ul style="list-style-type: none"> <li data-bbox="448 296 683 317">• We confirm that each sealed source, device, and source/device combination is registered as an approved sealed source or device by NRC or an Agreement State; | [] | N/A |
| | <ul style="list-style-type: none"> <li data-bbox="448 684 683 705">• We confirm that the activity per source and maximum activity in each device will not exceed the maximum activity listed on the approved certificate of registration issued by NRC or by an Agreement State | [] | N/A |
| | For depleted uranium, specify the total amount (in kilograms). | | [] |
| 5 | RADIOACTIVE MATERIAL (Cont'd) | | |
| | Financial Assurance and Record Keeping for Decommissioning | | |
| | If financial assurance is required, submit documentation required by 10 CFR 30.35. | | [] |
| 6. | PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED | | |
| | For radiopharmaceuticals: | | |

| Item No. | Title and Criteria | Yes | Description Attached |
|--|--|-----|----------------------|
| | <ul style="list-style-type: none"> <li data-bbox="448 285 683 296">• We confirm that radiopharmaceuticals will be prepared under the supervision of an ANP or will be obtained from a supplier authorized pursuant to 10 CFR 32.72; and | [] | |
| | <ul style="list-style-type: none"> <li data-bbox="448 711 683 722">• Describe all licensed material to be distributed or redistributed. | | [] |
| For generators: | | | |
| | <ul style="list-style-type: none"> <li data-bbox="448 921 683 932">• We confirm that the generators will be obtained from a manufacturer licensed pursuant to 10 CFR 32.72, or under equivalent Agreement State requirements; and | [] | |
| | <ul style="list-style-type: none"> <li data-bbox="448 1308 683 1318">• We confirm that unused generators will be redistributed without opening or altering the manufacturer's packaging. | [] | |
| 6. | PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED <i>(Cont'd)</i> | | |
| For redistribution of used generators: | | | |

| Item No. | Title and Criteria | Yes | Description Attached |
|----------|---|-----|----------------------|
| | <ul style="list-style-type: none"> • Describe the procedures and instructions for safely repackaging the generators, including the use of the manufacturer's original packaging and minimization of migration of radioactive fluids out of the generator during transport; | | [] |
| | <ul style="list-style-type: none"> • We confirm that the manufacturer's packaging and labeling will not be altered; | [] | |
| | <ul style="list-style-type: none"> • We confirm that the generator will not be distributed beyond the expiration date shown on the generator label; | [] | |
| | <ul style="list-style-type: none"> • We confirm that the redistributed generator will be accompanied by the manufacturer-supplied leaflet or brochure that provides radiation safety instructions for handling and using the generator; and | [] | |

| Item No. | Title and Criteria | Yes | Description Attached |
|---|---|-----|----------------------|
| | <ul style="list-style-type: none"> <li data-bbox="448 296 683 317">• We confirm that only generators used in accordance with the manufacturer's instructions will be redistributed. | [] | |
| For Redistribution of Sealed Sources C for Brachytherapy or Diagnosis: | | | |
| | <ul style="list-style-type: none"> <li data-bbox="448 627 683 648">• We confirm that the sealed sources for brachytherapy or diagnosis to be redistributed will be obtained from a manufacturer authorized to distribute sealed sources for brachytherapy or diagnosis in accordance with a specific license issued pursuant to 10 CFR 32.74 or under equivalent Agreement State requirements; and | [] | |

| Item No. | Title and Criteria | Yes | Description Attached |
|----------|--|-----|----------------------|
| | <ul style="list-style-type: none"> We confirm that the manufacturer's packaging, labeling, and shielding will not be altered and that redistributed sources will be accompanied by the manufacturer-supplied package insert, leaflet, brochure, or other document that provides radiation safety instructions for handling and storing the sources. | [] | |
| 6. | PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED <i>(Cont'd)</i> | | |
| | For Redistribution of Calibration and Reference Sealed Sources: | | |
| | <ul style="list-style-type: none"> We confirm that calibration and reference sealed sources to be redistributed to medical use licensees will be obtained from a person licensed pursuant to 10 CFR 32.74 to initially distribute such sources; and | [] | |

| Item No. | Title and Criteria | Yes | Description Attached |
|--|--|-----|----------------------|
| | <ul style="list-style-type: none"> <li data-bbox="448 296 683 317">• We confirm that the manufacturer's labeling and packaging will not be altered and that redistributed sources will be accompanied by the manufacturer-supplied calibration certificate and the leaflet, brochure, or other document that provides radiation safety instructions for handling and storing the sources. | [] | |
| For Redistribution of Prepackaged Units for <i>In Vitro</i> Tests: | | | |
| | <ul style="list-style-type: none"> <li data-bbox="448 1115 683 1136">• We confirm that the prepackaged units for in vitro tests to be redistributed will have been obtained from a manufacturer authorized to distribute the prepackaged units for in vitro tests in accordance with a specific license issued pursuant to 10 CFR 32.71 or under an equivalent license of an Agreement State. | [] | |
| For Redistribution to General Licensees: | | | |

| Item No. | Title and Criteria | Yes | Description Attached |
|----------|--|-----|----------------------|
| | <ul style="list-style-type: none"> <li data-bbox="448 285 683 296">• We confirm that the manufacturer's packaging and labeling of the prepackaged units for <i>in vitro</i> tests will not be altered in any way; and | [] | |
| | <ul style="list-style-type: none"> <li data-bbox="448 600 683 611">• We confirm that each redistributed prepackaged unit for <i>in vitro</i> tests will be accompanied by the manufacturer-supplied package insert, leaflet, or brochure that provides radiation safety instructions for general licensees. | [] | |
| 6. | PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED <i>(Cont'd)</i> | | |
| | For radiopharmaceutical preparation, we will perform: | | |
| | <ul style="list-style-type: none"> <li data-bbox="448 1272 683 1283">• compounding of iodine-131 capsules; | [] | |
| | <ul style="list-style-type: none"> <li data-bbox="448 1398 683 1409">• radioiodination; | [] | |
| | <ul style="list-style-type: none"> <li data-bbox="448 1451 683 1461">• technetium-99m kit preparation; and | [] | |
| | <ul style="list-style-type: none"> <li data-bbox="448 1577 683 1587">• other, specify. | [] | [] |
| | Supply specific information concerning the use of sealed sources for reference and calibration, and depleted uranium. | | |
| | We will provide customer the following radiation protection services involving licensed material: | | |
| | <ul style="list-style-type: none"> <li data-bbox="448 1871 683 1881">• leak testing; | [] | [] |

| Item No. | Title and Criteria | Yes | Description Attached |
|------------|--|-----|----------------------|
| | <ul style="list-style-type: none"> instrument calibration; and | [] | [] |
| | <ul style="list-style-type: none"> other, specify. | [] | [] |
| 7. | INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE | | |
| | For applicant's management structure, provide: | | |
| | <ul style="list-style-type: none"> An organizational chart describing the management structure, reporting paths, and the flow of authority between executive management and the RSO. | | [] |
| 7. | INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE (Cont'd) | | |
| | For the Radiation Safety Officer (RSO), provide: | | |
| | <ul style="list-style-type: none"> Name of the proposed RSO; | [] | |
| AND | | | |
| | <ul style="list-style-type: none"> A copy of the license (NRC or Agreement State) that authorized the uses requested and on which the individual was specifically named as the RSO, an ANP, or an AU; | | [] |
| OR | | | |

| Item No. | Title and Criteria | Yes | Description Attached |
|--|--|-----|----------------------|
| | <ul style="list-style-type: none"> Description of the training and experience demonstrating that the proposed RSO is qualified by training and experience as applicable to commercial nuclear pharmacies. | | [] |
| <p><i>Note:</i> See Appendix G for convenient formats to use for documenting hours of training in basic radioisotope handling techniques and hours of experience using radioisotopes. Figures G-1 and G-2 are specific to RSO training and experience.</p> | | | |
| 7. | <p>INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE (Cont'd)</p> | | |
| <p>For each proposed Authorized Nuclear Pharmacist (ANP), provide the following:</p> | | | |
| | <ul style="list-style-type: none"> Name of the pharmacist; | | [] |
| <p>AND</p> | | | |
| | <ul style="list-style-type: none"> A copy of the State pharmacy licensure or registration of the pharmacist; | [] | |
| <p>AND</p> | | | |
| | <ul style="list-style-type: none"> A copy of the license (NRC or Agreement State) on which the individual was specifically named as an ANP; | [] | |
| <p>OR</p> | | | |

| Item No. | Title and Criteria | Yes | Description Attached |
|-----------|---|-----|----------------------|
| | <ul style="list-style-type: none"> <li data-bbox="448 296 683 554">A copy of the permit maintained by a licensee of broad scope that identifies the individual as ANP; | [] | |
| OR | | | |
| | <ul style="list-style-type: none"> <li data-bbox="448 625 683 1026">A copy of previous NRC license issued to a commercial radiopharmacy prior to December 2, 1994, on which the pharmacist was specifically named as an authorized user; | [] | |
| OR | | | |
| | <ul style="list-style-type: none"> <li data-bbox="448 1098 683 1352">A copy of the pharmacist's certification(s) from the radiopharmacy board(s) approved by NRC; | [] | |
| 7. | INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE (Cont'd) | | |
| OR | | | |

| Item No. | Title and Criteria | Yes | Description Attached |
|---|---|-----|----------------------|
| | <ul style="list-style-type: none"> Description of the training and experience demonstrating that the proposed ANP is qualified by training and experience; and written certification, signed by a preceptor ANP, that the above training and experience has been satisfactorily completed and that the individual has achieved a level of competency sufficient to independently operate a nuclear pharmacy; | | [] |
| AND | | | |
| | <ul style="list-style-type: none"> Description of the recentness of training, if necessary. | | [] |
| 7. | INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE (<i>Cont'd</i>) | | |
| For each proposed Authorized User (AU), provide the following: | | | |
| | <ul style="list-style-type: none"> Name of each proposed AU; | | [] |
| AND | | | |
| | <ul style="list-style-type: none"> Identify types, quantities, and proposed uses of licensed material; | | [] |

| Item No. | Title and Criteria | Yes | Description Attached |
|------------|--|-----|----------------------|
| AND | | | |
| | <ul style="list-style-type: none"> • A copy of license (NRC or Agreement State) on which the individual was specifically named as an AU for the types, quantities, and proposed uses of licensed materials; | [] | |
| OR | | | |
| | <ul style="list-style-type: none"> • A copy of the permit maintained by a licensee of broad scope that identifies the individual as an AU for the types, quantities, and proposed uses of licensed materials; | [] | |
| OR | | | |

| Item No. | Title and Criteria | Yes | Description Attached |
|----------|---|-----|----------------------|
| | <ul style="list-style-type: none"> Description of the training and experience demonstrating that the proposed AU is qualified by training and experience to use the requested licensed materials. The applicant may find it convenient to describe this training and experience using a format similar to Figures G-1 and G-2 in Appendix G. | | [] |
| 8. | TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS (INSTRUCTIONS TO OCCUPATIONALLY EXPOSED WORKERS AND ANCILLARY PERSONNEL) | | |
| | Occupationally Exposed Workers and Ancillary Personnel | | |
| | We have developed and will implement and maintain written procedures for a training program for each group of workers, including: topics covered; qualifications of the instructors; method of training; method for assessing the success of the training; and the frequency of training and refresher training. | [] | |
| | Personnel Involved in Hazardous Materials Package Preparation and Transport | | |

| Item No. | Title and Criteria | Yes | Description Attached |
|------------------------------------|--|---|----------------------|
| | We have developed and will implement and maintain written procedures for training personnel involved in hazardous materials package preparation and transport that meet the requirements in 49 CFR 172.700, 49 CFR 172.702, and 49 CFR 172.704, as applicable. | [] | |
| | Instruction for Supervised Individuals Preparing Radiopharmaceuticals | Need Not Be Submitted with Application | |
| 9. | FACILITIES AND EQUIPMENT | | |
| | Provide a copy of the registration or license from a State Board of Pharmacy as a pharmacy; or provide evidence that the facility is operating as a nuclear pharmacy within a Federal medical institution; | [] | [] |
| AND | | | |
| | Describe the facilities and equipment to be made available at each location where radioactive material will be used. A diagram should be submitted showing the applicant's entire facility and identify activities conducted in all contiguous areas surrounding the facility. Diagrams should be drawn to a specified scale, or dimensions should be indicated. | | [] |
| Include the following information: | | | |

| Item No. | Title and Criteria | Yes | Description Attached |
|----------|---|-----|----------------------|
| | <ul style="list-style-type: none"> • Descriptions of the area(s) assigned for the receipt, storage, preparation, and measurement of radioactive materials and the location(s) for radioactive waste storage; | | [] |
| | <ul style="list-style-type: none"> • Sufficient detail in the diagram to indicate locations of shielding, the proximity of radiation sources to unrestricted areas, and other items related to radiation safety; | | [] |

| Item No. | Title and Criteria | Yes | Description Attached |
|------------|--|---|----------------------|
| | <ul style="list-style-type: none"> • Descriptions of the ventilation systems, including gloveboxes or fume hoods, with pertinent airflow rates, area differential pressures, filtration equipment, and monitoring systems for the use or storage of radioactive materials with the probability of becoming airborne, such as compounding radioiodine capsules and dispensing radioiodine solutions; and | | [] |
| | <ul style="list-style-type: none"> • Verification that ventilation systems ensure that effluents are within 10 CFR 20.1301 and are ALARA constraints for air emissions established under 10 CFR 20.1101(d) | | [] |
| 10. | RADIATION SAFETY PROGRAM | Need Not be Submitted with Application | |
| | Audit Program | | |

| Item No. | Title and Criteria | Yes | Description Attached |
|------------|--|-----|----------------------|
| | The applicant's program for reviewing the content and implementation of its radiation protection program will be examined during inspections, but it should not be submitted in the license application. | | |
| | Instruments | | |
| | We will use equipment that meets the radiation monitoring instrument specifications and implement the model survey meter calibration program published in Appendix J to NUREG - 1556, Vol. 13, "Program-Specific Guidance About Radiopharmacy Licenses," dated September 1999; | [] | |
| | OR | | |
| | We will use equipment that meets the radiation monitoring instrument specifications published in Appendix J to NUREG - 1556, Vol. 13, "Program-Specific Guidance About Radiopharmacy Licenses," dated September 1999, and instruments will be calibrated by other persons authorized by the NRC, an Agreement State, or a licensing State to perform that service; | [] | |
| | OR | | |
| | A description of alternative minimum equipment to be used for radiation monitoring and/or alternative procedures for the calibration of radiation monitoring equipment. | | [] |
| 10. | RADIATION SAFETY PROGRAM (Cont'd) | | |
| | Material Receipt and Accountability | | |

| Item No. | Title and Criteria | Yes | Description Attached |
|-------------------------------|---|-----|----------------------|
| | We have developed, and will implement and maintain written procedures for safely opening packages that meet the requirements in 10 CFR 20.1906; | [] | |
| AND | | | |
| | We will conduct physical inventories of sealed sources of licensed material at intervals not to exceed 6 months; | [] | |
| AND | | | |
| | We have developed, and will implement and maintain written procedures for licensed material accountability and control to ensure that: | [] | |
| | <ul style="list-style-type: none"> • license possession limits are not exceeded; | | |
| | <ul style="list-style-type: none"> • licensed material in storage is secured from unauthorized access or removal; | | |
| | <ul style="list-style-type: none"> • licensed material not in storage is maintained under constant surveillance and control; and | | |
| | <ul style="list-style-type: none"> • records of receipt, transfer, and disposal of licensed material are maintained. | | |
| Occupational Dosimetry | | | |

| Item No. | Title and Criteria | Yes | Description Attached |
|------------|--|---|----------------------|
| | We have developed and will implement and maintain written procedures for monitoring occupational dose that meet the requirements in 10 CFR 20.1501, 10 CFR 20.1502, 10 CFR 20.1201, 10 CFR 20.1202, 10 CFR 20.1203, 10 CFR 20.1204, 10 CFR 20.1207, 10 CFR 20.1208, and 10 CFR 20.2106, as applicable. | [] | |
| 10. | RADIATION SAFETY PROGRAM (Cont'd) | Need Not Be Submitted with Application | |
| | Public Dose | | |
| | The applicant's program to control doses received by individual members of the public will be examined during inspection, but it should not be submitted in a license application. | | |
| | Safe Use of Radionuclides and Emergency Procedures | | |
| | We have developed and will implement and maintain written procedures for the safe use of radioactive materials that address: | [] | |
| | <ul style="list-style-type: none"> • facility and personnel radioactive contamination minimization, detection, and control; | | |
| | <ul style="list-style-type: none"> • performing molybdenum-99 breakthrough measurements on all generator elutions used to prepare radioactive drugs for human medical use; and | | |

| Item No. | Title and Criteria | Yes | Description Attached |
|------------|---|-----|----------------------|
| | <ul style="list-style-type: none"> use of protective clothing and equipment by personnel | | |
| | that meet the requirements in 10 CFR 20.1101, 10 CFR 20.1801, 10 CFR 20.1802, 10 CFR 30.34(g), and 10 CFR 19.11(a)(3), as applicable; | | |
| 10. | RADIATION SAFETY PROGRAM (Cont'd) | | |
| | AND | | |
| | We have developed and will implement and maintain written procedures for identifying and responding to emergencies involving radioactive material, including: | [] | |
| | <ul style="list-style-type: none"> lost, stolen, or missing licensed material; | | |
| | <ul style="list-style-type: none"> exposures to personnel and the public in excess of NRC regulatory limits; | | |
| | <ul style="list-style-type: none"> releases of licensed materials in effluents and the sanitary sewer in excess of NRC regulatory limits; | | |
| | <ul style="list-style-type: none"> excessive radiation levels or radioactive material concentrations in restricted or unrestricted areas; | | |
| | <ul style="list-style-type: none"> radioactive spills and contamination; | | |

| Item No. | Title and Criteria | Yes | Description Attached |
|---|--|-----|----------------------|
| | <ul style="list-style-type: none"> fires, explosions, and other disasters with the potential for the loss of containment of licensed material; and | | |
| | <ul style="list-style-type: none"> routine contacts with local fire departments | | |
| that meet the requirements in 10 CFR 20.1101, 10 CFR 20.2201-2203, and 10 CFR 30.50, as applicable. | | | |
| Surveys | | | |
| | We have developed and will implement and maintain written procedures for a survey program that specifies the performance of radiation and contamination level surveys in restricted and unrestricted areas, personnel contamination monitoring, action levels, and the frequencies and records maintenance of those surveys and monitoring that meet the requirements in 10 CFR 30.53, 10 CFR 20.1501, and 10 CFR 20.2103 as applicable. | [] | |
| 10. | RADIATION SAFETY PROGRAM (Cont'd) | | |
| Dosage Measurement Systems | | | |
| | Describe the types of systems (measurement or combination of measurement and calculation) to be used for the measurement of alpha-, beta-, and photon-emitting radioactive drugs; | | [] |
| AND | | | |

| Item No. | Title and Criteria | Yes | Description Attached |
|--------------------------------------|--|---|----------------------|
| | For each dose measurement system used to measure the amount of radioactivity in alpha-, beta-, or photon-emitting radioactive drugs, state: "We have developed, and will implement and maintain a written procedure for the performance of dosage measurement system checks and tests that meets the requirements in 10 CFR 32.72(c)"; | [] | |
| AND | | | |
| | If applicable, include a sample calculation for determining beta-correction factors for dose calibrators with ionization chambers; | | [] |
| OR | | | |
| | If applicable, include a means for ensuring the accuracy of beta-correction factors supplied by the instrument manufacturer or other entity. | | [] |
| Transportation | | Need Not Be Submitted with Application | |
| | The applicant's program for transportation will be examined during inspection, but should not be submitted in a license application. | | |
| 10. | RADIATION SAFETY PROGRAM (Cont'd) | Need Not Be Submitted with Application | |
| Minimization of Contamination | | | |

| Item No. | Title and Criteria | Yes | Description Attached |
|--|--|-----|----------------------|
| | <p>The applicant does not need to provide a response to this item under the following condition: NRC will consider that the criteria have been met if the applicant's responses meet the criteria for the following sections: "Facilities and Equipment; Radiation Safety Program - Safe Use of Radionuclides and Emergency Procedures; Radiation Safety Program - Surveys; Radiation Safety Program - Leak Testing; and Waste Management" of NUREG - 1556, Vol. 13, dated September 1999.</p> | | |
| Radioactive Drug Labeling for Distribution | | | |
| | <p>Describe all labels, indicating the colors to be used, that will accompany the products and describe where each label is placed (e.g., on the "transport radiation shield" or the container used to hold the radioactive drug); and agree to affix the required labels to all "transport radiation shields" and each container used to hold the radioactive drugs.</p> | | |
| Radioactive Drug Shielding for Distribution | | | |
| | <p>For each radioactive drug to be distributed (except for products intended for redistribution without manipulation and in the manufacturer's original shipping package), provide:</p> | [] | |
| | <ul style="list-style-type: none"> • The radionuclide and the maximum activity for each type of container (e.g., vial, syringe); | | |
| | <ul style="list-style-type: none"> • Describe the type and thickness of the "transport radiation shield" provided for each type of container; and | | |

| Item No. | Title and Criteria | Yes | Description Attached |
|------------|--|-----|----------------------|
| | <ul style="list-style-type: none"> Indicate the maximum radiation level to be expected at the surface of each "transport radiation shield" when the radioactive drug container is filled with the maximum activity. | | |
| 10. | RADIATION SAFETY PROGRAM (Cont'd) | | |
| | Leak Tests | | |
| | We have developed and will implement and maintain written procedures for leak testing that meet the requirements in 10 CFR 30.53, 10 CFR 20.1501, and 10 CFR 20.2103 | [] | |

Appendix D: Checklist for License Application

D.1 ITEM 1: ACTION TYPE

| ACTION TYPE: | ADMINISTRATIVE REVIEW: |
|---------------|--|
| [] New | [] Current Guidance Used |
| [] Amendment | [] References in Application Based On Current Regulations |
| [] Renewal | [] All Attachments Referenced Included |
| | [] Signature on Application |

D.2 ITEM 2: LEGAL IDENTITY

| |
|-------|
| NAME: |
|-------|

D.3 ITEMS 2 & 3: ADDRESS

STORAGE & LOCATION OF USE ADDRESS:

MAILING ADDRESS:

D.4 ITEM 4: PERSON TO BE CONTACTED ABOUT THIS APPLICATION

CONTACT PERSON:

TELEPHONE NUMBER:

D.5 ITEMS 5 & 6: MATERIALS TO BE POSSESSED AND PROPOSED USES

| Yes | No | Radioisotope | Form or Mfg/Model No. | Quantity | Purpose of Use | Specify Other Uses Not Listed on SSD Certificate |
|-----|----|--|-----------------------|----------|---|--|
| | | Byproduct Materials with Atomic No. 1-83 | Any | — | millicuries per nuclide, 1 curie total possession, except as noted: | 10 CFR 32.72 [] Not applicable |
| | | | | | and 10 CFR 30.41 [] Uses are: | |
| | | Molybdenum-99 | Any | — | curies | 10 CFR 32.72 [] Not applicable |
| | | | | | and 10 CFR 30.41 [] Uses are: | |
| | | Technetium-99m | Any | — | curies | 10 CFR 32.72 [] Not applicable |
| | | | | | and 10 CFR 30.41 [] Uses are: | |
| | | Iodine-131 | Any | — | Millicuries | 10 CFR 32.72 [] Not applicable |
| | | | | | and [] Uses are: | |

| | | | | | | | | |
|--|--|---|---|---|-------------------|--------------|-----|----------------|
| | | | | | | 10 CFR 30.41 | | |
| | | Xenon-133 | Any | — | curies | 10 CFR 32.72 | [] | Not applicable |
| | | | | | | and | [] | Uses are: |
| | | | | | | 10 CFR 30.41 | | |
| | | | | | | | | |
| | | Any Byproduct Material in a Brachytherapy Source, as listed in 10 CFR 35.400 | Sealed Sources | — | Millicuries | 10 CFR 32.72 | [] | Not applicable |
| | | | | | | and | [] | Uses are: |
| | | | | | | 10 CFR 30.41 | | |
| | | Any Byproduct Material in a sealed source for diagnosis, as listed in 10 CFR 35.500 | Sealed Sources | — | Curies per source | 10 CFR 32.72 | [] | Not applicable |
| | | | | | and | and | [] | Uses are: |
| | | | | | curies total | 10 CFR 30.41 | | |
| | | Any byproduct material listed in 10 CFR 3111(a) | Prepackaged units for in vitro diagnostic tests | — | Millicuries | 10 CFR 32.72 | [] | Not applicable |
| | | | | | | and | [] | Uses are: |
| | | | | | | 10 CFR 30.41 | | |

| | | | | | | | |
|--|---|----------------|-------|-------------|-------------------------------------|------------|-----------------------------|
| | Any byproduct material authorized under 10 CFR 35.57(a) | Sealed Sources | _____ | Millicuries | 10 CFR 32.72 and 10 CFR 30.41 | [] [] | Not applicable Uses are: |
| | Depleted Uranium | | | | 10 CFR 32.72 and 10 CFR 30.41 | [] [] | Not applicable Uses are: |
| | Cesium-137 | | | | 10 CFR 32.72 and 10 CFR 30.41 | [] [] | Not applicable Uses are: |
| | Other (specify) | | | | | | |

D.6 ITEMS 7 THROUGH 11: TRAINING AND EXPERIENCE, FACILITIES AND EQUIPMENT, RADIATION SAFETY PROGRAM, AND WASTE DISPOSAL

| Item Number and Title | Suggested Response | Yes | Alternative Procedures Attached | |
|-----------------------|--|--|---------------------------------|-----|
| 7. | Individual(s) Responsible for Radiation Safety Program and Their Training and Experience | An organizational chart describing the management structure, reporting paths, and the flow of authority between executive management and the radiation safety officer. | [] | [] |
| 7.1 | Management Structure | | | |

| Item Number and Title | Suggested Response | | Yes | Alternative Procedures Attached |
|-----------------------|--|---|-----|---------------------------------|
| 7. | Individual(s) Responsible For Radiation Safety Program And Their Training And Experience | A copy of the license (NRC or Agreement State) that authorized the uses requested and on which the individual was specifically named as the RSO, an ANP, or an AU; | [] | [] |
| 7.2 Name: _____ | Radiation Safety Officer (RSO) | OR | | |
| _____ | | Description of the training and experience demonstrating that the proposed RSO is qualified by training and experience as applicable to commercial nuclear pharmacies | [] | |
| 7. | Individual(s) Responsible for Radiation Safety Program and Their Training and Experience | A copy of the State pharmacy licensure or registration for the pharmacist; | [] | [] |
| 7.3 Name(s): _____ | Authorized Nuclear Pharmacist(s) | AND | | |
| _____ | | A copy of the license (NRC or Agreement State) on which the individual was specifically named as an ANP; | [] | |
| | | OR | | |
| | | A copy of the permit maintained by a licensee of broad scope that identifies the individual as ANP; | [] | |
| | | OR | | |
| | | A copy of previous NRC license issued to a commercial radiopharmacy prior to December 2, 1994, on which the pharmacist was specifically named as an authorized user | [] | |

| Item Number and Title | Suggested Response | | Yes | Alternative Procedures Attached |
|-----------------------|--|---|-----|---------------------------------|
| | | OR | | |
| | | A copy of the pharmacist's certification(s) from the radiopharmacy board(s) approved by the NRC; | [] | |
| | | OR | | |
| | | Description of the training and experience demonstrating that the proposed ANP is qualified by training and experience; and written certification, signed by a preceptor ANP, that the above training and experience has been satisfactorily completed and that the individual has achieved a level of competency sufficient to independently operate a nuclear pharmacy; | [] | [] |
| | | AND | | |
| | | Description of the recentness of training, if necessary. | [] | |
| 7. | Individual(s) Responsible for Radiation Safety Program and Their Training and Experience | Identify types, quantities, and proposed uses of licensed material; | [] | [] |
| | | AND | | |
| 7.4 | Authorized User(s) | A copy of license (NRC or Agreement State) on which the individual was specifically named as an AU for the types, quantities, and proposed uses of licensed materials; | [] | |
| Name(s): _____ | | | | |
| | | OR | | |

| Item Number and Title | Suggested Response | | Yes | Alternative Procedures Attached |
|-----------------------|--|--|-----|---------------------------------|
| | A copy of the permit maintained by a licensee of broad scope that identifies the individual as an AU for the types, quantities, and proposed uses of licensed materials; | | [] | |
| | OR | | | |
| | Description of the training and experience demonstrating that the proposed AU is qualified by training and experience to use the requested licensed materials | | [] | |
| 8. | Training for Individuals Working or Frequenting Restricted Areas (Occupationally Exposed and Ancillary Personnel) | We have developed and will implement and maintain written procedures for a training program for each group of workers, including: topics covered; qualifications of the instructors; method of training; method for assessing the success of the training; and the frequency of training and refresher training. | [] | [] |
| 8. | Training for Personnel Involved in Hazardous Materials Package Preparation and Transport | We have developed and will implement and maintain written procedures for training personnel involved in hazardous materials package preparation and transport that meet the requirements in 49 CFR 172.700, 49 CFR 172.702, and 49 CFR 172.704, as applicable. | [] | [] |

| Item Number and Title | Suggested Response | Yes | Alternative Procedures Attached |
|-----------------------|--|--|---------------------------------|
| 8. | Training for Supervised Individuals Preparing Radiopharmaceuticals | The applicant's program for training of supervised individuals preparing radiopharmaceuticals will be examined during inspections, but should not be submitted in the license application. | N/A |
| 9. | Facilities and Equipment | Provide a copy of the registration or license from a State Board of Pharmacy as a pharmacy; or provide evidence that the facility is operating as a nuclear pharmacy within a Federal medical institution; | [] |
| | | <p style="text-align: center;">AND</p> Describe the facilities and equipment to be made available at each location where radioactive material will be used. A diagram should be submitted showing the applicant's entire facility and identify activities conducted in all contiguous areas surrounding the facility. Diagrams should be drawn to a specified scale, or dimensions should be indicated. | [] |
| | | | |
| | Include the following information: | | |

| Item Number and Title | Suggested Response | | Yes | Alternative Procedures Attached |
|-----------------------|---|---|-----|---------------------------------|
| | <ul style="list-style-type: none"> • | Descriptions of the area(s) assigned for the receipt, storage, preparation, and measurement of radioactive materials and the location(s) for radioactive waste storage; | [] | [] |
| | <ul style="list-style-type: none"> • | Sufficient detail in the diagram to indicate locations of shielding, the proximity of radiation sources to unrestricted areas, and other items related to radiation safety; | [] | |

| Item Number and Title | Suggested Response | Yes | Alternative Procedures Attached |
|-----------------------|--|-----|---------------------------------|
| | <ul style="list-style-type: none"> • Descriptions of the ventilation systems, including gloveboxes or fume hoods, with pertinent airflow rates, area differential pressures, filtration equipment, and monitoring systems for the use or storage of radioactive materials with the probability of becoming airborne, such as compounding radioiodine capsules and dispensing radioiodine solutions; and | [] | |
| | <ul style="list-style-type: none"> • Verification that ventilation systems ensure that effluents are within 10 CFR 20.130.1 and the ALARA constraints for air emissions established under 10 CFR 20.1101(d). | [] | |

| Item Number and Title | Suggested Response | | Yes | Alternative Procedures Attached |
|-----------------------|--------------------------|--|-----|---------------------------------|
| 10. | Radiation Safety Program | The applicant's program for reviewing the content and implementation of its radiation protection program will be examined during inspections, but it should not be submitted in the license application. | | N/A |
| 10.1 | Audit Program | | | |
| 10. | Radiation Safety Program | We will use equipment that meets the radiation monitoring instrument specifications and implement the model survey meter calibration program published in Appendix J to NUREG - 1556, Vol. 13, "Program-Specific Guidance About Radiopharmacy Licenses," dated September 1999; | [] | [] |
| 10.2 | Survey Instruments | | | |
| | | OR | | |
| | | We will use equipment that meets the radiation monitoring instrument specifications published in Appendix J to NUREG - 1556, Vol. 13, "Program-Specific Guidance About Radiopharmacy Licenses," dated September 1999, and instruments will be calibrated by persons authorized by the NRC, an Agreement State, or a licensing State to perform that service; | [] | |
| | | OR | | |

| Item Number and Title | Suggested Response | | Yes | Alternative Procedures Attached |
|-----------------------|---|--|-----|---------------------------------|
| | A description of alternative minimum equipment to be used for radiation monitoring and/or alternative procedures for the calibration of radiation monitoring equipment. | | [] | [] |
| 10. | Radiation Safety Program | We have developed, and will implement and maintain, written procedures for safely opening packages that meet the requirements in 10 CFR 20.1906; | [] | [] |
| 10.3 | Material Receipt and Accountability | | | |
| | AND | | | |
| | We will conduct physical inventories of sealed sources of licensed material at intervals not to exceed six months; | | [] | |
| | AND | | | |
| | We have developed, and will implement and maintain written procedures for licensed material accountability and control to ensure that: | | [] | |
| | • | License possession limits are not exceeded; | | |
| | • | Licensed material in storage is secured from unauthorized access or removal; | | |

| Item Number and Title | Suggested Response | | Yes | Alternative Procedures Attached | |
|-----------------------|---|--|---|---------------------------------|--|
| | | <ul style="list-style-type: none"> • | Licensed material not in storage is maintained under constant surveillance and control; and | | |
| | | <ul style="list-style-type: none"> • | Records of receipt, transfer, and disposal of licensed material are maintained. | | |
| 10. | Radiation Safety Program | We have developed and will implement and maintain written procedures for monitoring occupational dose that meet the requirements in 10 CFR 20.1501, 10 CFR 20.1502, 10 CFR 20.1201, 10 CFR 20.1202, 10 CFR 20.1203, 10 CFR 20.1204, 10 CFR 20.1207, 10 CFR 20.1208, and 10 CFR 20.2106, as applicable. | [] | [] | |
| 10.4 | Occupational Dosimetry | | | | |
| 10. 10.5 | Radiation Safety Program Public Dose | The applicant's program to control doses received by individual members of the public will be examined during inspection, but it should not be submitted in a license application. | | N/A | |

| Item Number and Title | Suggested Response | | Yes | Alternative Procedures Attached |
|-----------------------|--|---|-----|---------------------------------|
| 10. 10.6 | Radiation Safety Program Safe Use of Radionuclides and Emergency Procedures | <p>We have developed and will implement and maintain written procedures for the safe use of radioactive materials that address:</p> <ul style="list-style-type: none"> • Facility and personnel radioactive contamination minimization, detection, and control; • Performing molybdenum-99 breakthrough measurements on all generator elutions used to prepare radioactive drugs for human medical use; and • Use of protective clothing and equipment by personnel <p>that meet the requirements in 10 CFR 20.1101, 10 CFR 20.1801, 10 CFR 20.1802, 10 CFR 30.34(g), and 10 CFR 19.11(a)(3), as applicable.</p> | [] | [] |

| Item Number and Title | Suggested Response | | Yes | Alternative Procedures Attached |
|-----------------------|--|---|-----|---------------------------------|
| 10 10.7 | Radiation Safety Program Safe Use of Radionuclides and Emergency Procedures | <p>We have developed and will implement and maintain written procedures for identifying and responding to emergencies involving radioactive material, including</p> <ul style="list-style-type: none"> • Lost, stolen, or missing licensed material; • Exposures to personnel and the public in excess of NRC regulatory limits; • Releases of licensed materials in effluents and the sanitary sewer in excess of NRC regulatory limits; • Excessive radiation levels or radioactive material concentrations in restricted or unrestricted areas; • Radioactive spills and contamination; | [] | [] |

| Item Number and Title | Suggested Response | | Yes | Alternative Procedures Attached |
|-----------------------|--|---|-----|---------------------------------|
| | | <ul style="list-style-type: none"> <li data-bbox="607 323 1019 667">• Fires, explosions, and other disasters with the potential for the loss of containment of licensed material; and <li data-bbox="607 667 1019 827">• Routine contacts with local fire departments <p data-bbox="607 827 1019 980">that meet the requirements in 10 CFR 20.1101, 10 CFR 20.2201, 20.2202, 20.2203, and 10 CFR 30.50, as applicable.</p> | | |
| 10 | Radiation Safety Program | We have developed, and will implement and maintain, written procedures for a survey program that specifies the performance of radiation and contamination level surveys in restricted and unrestricted areas, personnel contamination monitoring, action levels, and the frequencies and records maintenance of those surveys and monitoring that meet the requirements in 10 CFR 30.53, 10 CFR 20.1501, and 10 CFR 20.2103, as applicable. | [] | [] |
| 10.8 | Surveys | | | |
| 10 10.9 | Radiation Safety Program Dosage Measurement Systems | Describe the types of systems (measurement or combination of measurement and calculation) to be used for the measurement of alpha-, beta-, and photon-emitting radioactive drugs; | [] | [] |

| Item Number and Title | Suggested Response | | Yes | Alternative Procedures Attached |
|-----------------------|---|---|-----|---------------------------------|
| | AND | | | |
| | | For each dosage measurement system used to measure the amount of radioactivity in alpha-, beta-, or photon-emitting radioactive drugs, state: “We have developed, and will implement and maintain, a written procedure for the performance of dosage measurement system checks and tests that meets the requirements in 10 CFR 32.72(c)”; | [] | [] |
| | AND | | | |
| | | If applicable, include a sample calculation for determining beta-correction factors for dose calibrators with ionization chambers; | [] | [] |
| | OR | | | |
| | | If applicable, include a means for ensuring the accuracy of beta-correction factors supplied by the instrument manufacturer or other entity. | [] | [] |
| 10 10.10 | Radiation Safety Program Transportation | The applicant’s program for transportation will be examined during inspection, but it should not be submitted in a license application. | N/A | |
| 10 10.11 | Radiation Safety Program Minimization of Contamination | The applicant does not need to provide a response to this item under the following condition. NRC will consider that the criteria have been met if the applicant’s responses meet the criteria for the following sections: | | [] |

| Item Number and Title | Suggested Response | | Yes | Alternative Procedures Attached |
|-----------------------|---|--|---------------------------------|---------------------------------|
| | <ul style="list-style-type: none"> • • • • • | Facilities and Equipment; Radiation Safety Program - Safe Use of Radionuclides and Emergency Procedures; Radiation Safety Program - Surveys; Radiation Safety Program - Leak Testing; and Waste Management. | [] [] [] [] [] | |
| 10 10.12 | Radiation Safety Program Radioactive Drug Labeling for Distribution | Describe all labels, indicating the colors to be used, that will accompany the products and describe where each label is placed (e.g., on the “transport radiation shield” or the container used to hold the radioactive drug); and agree to affix the required labels to all “transport radiation shields” and each container used to hold the radioactive drugs. | [] | |
| 10 10.13 | Radiation Safety Program Radioactive Drug Shielding for Distribution | For each radioactive drug to be distributed (except for products intended for redistribution without manipulation and in the manufacturer’s original shipping package): | | |

| Item Number and Title | Suggested Response | | Yes | Alternative Procedures Attached |
|-----------------------|--|--|-----|---------------------------------|
| | • | Provide the radionuclide and the maximum activity for each type of container (e.g., vial, syringe); | [] | |
| | • | Describe the type and thickness of the “transport radiation shield” provided for each type of container; and | [] | |
| | • | Indicate the maximum radiation level to be expected at the surface of each “transport radiation shield” when the radioactive drug container is filled with the maximum activity. | [] | |
| 10 10.14 | Radiation Safety Program Leak Tests | We have developed, and will implement and maintain, written procedures for leak testing that meet the requirements in 10 CFR 30.53, 10 CFR 20.1501, and 10 CFR 20.2103 | [] | [] |

| Item Number and Title | Suggested Response | | Yes | Alternative Procedures Attached |
|-----------------------|--|---|-----|---------------------------------|
| 11. | Waste Management Pharmacy-Generated Radioactive Wastes | We have developed, and will implement and maintain, written procedures for waste management that meet the requirements in 10 CFR 20.2001(a), 10 CFR 20.2003, and 10 CFR 20.2006, 10 CFR 20.2108, 10 CFR 30.51, as applicable. | [] | [] |
| 11 | Waste Management Returned Wastes from Customers | We have developed and will implement and maintain written procedures for customer return of pharmacy supplied syringes and vials and their contents, to specify that: | [] | [] |
| | | <ul style="list-style-type: none"> <li data-bbox="604 913 808 1176">• | | |
| | | <ul style="list-style-type: none"> <li data-bbox="604 1188 808 1671">• | | |

only pharmacy supplied syringes and vials and their contents may be returned to the pharmacy;

instructions will be provided to radiopharmacy customers for the proper preparation and packaging of the radioactive waste for return to the radiopharmacy; and

| Item Number and Title | Suggested Response | Yes | Alternative Procedures Attached |
|-----------------------|---|-----|---------------------------------|
| | <ul style="list-style-type: none"> instructions will be provided to pharmacy staff for the pick-up, receipt and disposal of the returned radioactive waste | | |
| | that meet the requirements in 10 CFR 20.2001(a), 10 CFR 30.33, and 10 CFR 71.5, as applicable. | | |
| | | | |

Appendix E: Sample License

A sample license appears on the following pages.

Form 374 - Sample Materials License

| Form 374 - Sample Materials License | |
|-------------------------------------|---|
| Page | Title |
| 1 of 5 | <u>Materials License</u> |
| 2 of 5 | <u>Materials License(Supplementary Sheet)</u> |
| 3 of 5 | <u>Materials License(Supplementary Sheet)</u> |
| 4 of 5 | <u>Materials License(Supplementary Sheet)</u> |
| 5 of 5 | <u>Materials License(Supplementary Sheet)</u> |

Appendix F: Information Needed for Transfer of Control Application

Licensees must provide full information and obtain NRC's *prior written consent* before transferring control of the license; some licensees refer to this as "transferring the license." Provide the following information concerning changes of control by the applicant (transferor

and/or transferee, as appropriate). If any items are not applicable, so state.

| | |
|----|--|
| 1. | The new name of the licensed organization. If there is no change, the licensee should so state. |
| 2. | The new licensee contact and telephone number(s) to facilitate communications. |
| 3. | Any changes in personnel having control over licensed activities (e.g., officers of a corporation) and any changes in personnel named in the license such as radiation safety officer, authorized users, or any other persons identified in previous license applications as responsible for radiation safety or use of licensed material. The licensee should include information concerning the qualifications, training, and responsibilities of new individuals. |
| 4. | An indication of whether the transferor will remain in non-licensed business without the license. |
| 5. | A complete, clear description of the transaction, including any transfer of stocks or assets, mergers, etc., so that legal counsel is able, when necessary, to differentiate between name changes and transferring control. |
| 6. | A complete description of any planned changes in organization, location, facility, equipment, or procedures (i.e., changes in operating or emergency procedures). |
| 7. | A detailed description of any changes in the use, possession, location, or storage of the licensed materials. |
| 8. | Any changes in organization, location, facilities, equipment, procedures, or personnel that would require a license amendment even without transferring control. |
| 9. | An indication of whether all surveillance items and records (e.g., calibrations, leak tests, surveys, inventories, and accountability requirements) will be current at the time of transfer. Provide a description of the status of all surveillance requirements and records. |

| | |
|-----|---|
| 10 | Confirmation that all records concerning the safe and effective decommissioning of the facility, pursuant to 10 CFR 30.35(g), 40.36(f), 70.25(g), and 72.30(d); public dose; and waste disposal by release to sewers, incineration, radioactive material spills, and on-site burials, have been transferred to the new licensee, if licensed activities will continue at the same location, or to the NRC for license terminations. |
| 11. | A description of the status of the facility, specifically, the presence or absence of contamination should be documented. If contamination is present, will decontamination occur before transfer? If not, does the successor company agree to assume full liability for the decontamination of the facility or site? |
| 12. | A description of any decontamination plans, including financial assurance arrangements of the transferee, as specified in 10 CFR 30.35, 40.36, and 70.25. Include information about how the transferee and transferor propose to divide the transferor's assets, and responsibility for any cleanup needed at the time of transfer. |
| 13 | <p>Confirmation that the transferee agrees to abide by all commitments and representations previously made to NRC by the transferor. These include, but are not limited to: maintaining decommissioning records required by 10 CFR 30.35(g); implementing decontamination activities and decommissioning of the site; and completing corrective actions for open inspection items and enforcement actions.</p> <p>With regard to contamination of facilities and equipment, the transferee should confirm, in writing, that it accepts full liability for the site, and should provide evidence of adequate resources to fund decommissioning; or the transferor should provide a commitment to decontaminate the facility before transferring control.</p> |

| | |
|-----|---|
| | <p>With regard to open inspection items, etc., the transferee should confirm, in writing, that it accepts full responsibility for open inspection items and/or any resulting enforcement actions; or the transferee proposes alternative measures for meeting the requirements; or the transferor provides a commitment to close out all such actions with NRC before license transfer.</p> |
| 14. | <p>Documentation that the transferor and transferee agree to transferring control of the licensed material and activity, and the conditions of transfer; and the transferee is made aware of all open inspection items and its responsibility for possible resulting enforcement actions.</p> |
| 15 | <p>A commitment by the transferee to abide by all constraints, conditions, requirements, representations, and commitments identified in the existing license. If not, the transferee must provide a description of its program, to ensure compliance with the license and regulations.</p> |

Appendix G: Model Formats for Documenting Training and Experience for Individuals Responsible for Radiation Protection Program

3 Using and performing checks for proper operation of instruments used to measure alpha- and low energy beta- emitting radionuclides

4 Calculating, assaying, and safely preparing radioactive materials

5 Use of procedures to prevent or minimize contamination and/or use of proper decontamination procedures

Figure G-3 Authorized Nuclear Pharmacist Training in Basic Radioisotope Handling Techniques

| |
|-----------------------------|
| Name (Last, First, Initial) |
|-----------------------------|

| Location of Training | Dates | Title | Total Hours | Breakdown of Course in Clock Hours | | | | |
|----------------------|-------|-------|-------------|------------------------------------|----|------|----|------|
| | | | | RP&I | RP | MATH | RB | CHEM |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | TOTALS | | | | | |

| | |
|--|------|
| Signature of Preceptor Authorized Nuclear Pharmacist: “I certify that the above described training/experience has been satisfactorily completed and that the individual has achieved a level of competency sufficient to independently operate a nuclear pharmacy.” | Date |
|--|------|

RP&I - Radiation Protection Principles RP - Biological Hazards

RB - Ionizing Radiation Units & Characteristics Math - Radiation detection instrumentation

Chem - NRC Regulations and Standards

Figure G-4 Authorized Nuclear Pharmacist Experience in Handling Radioisotopes

(Actual use of radioisotopes under the supervision of an authorized user or Radiation Safety Officer, respectively)

| |
|-----------------------------|
| Name (Last, First, Initial) |
|-----------------------------|

| Isotope(s) used | Maximum amount used at any one time | Location of use | Purpose of use* | Total Hours of Experience |
|-----------------|-------------------------------------|-----------------|-----------------|---------------------------|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

| | | | | |
|--|--|--|--|--|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

| | |
|---|-------------|
| <p>Signature of Preceptor Authorized Nuclear Pharmacist:</p> <p>“I certify that the above described training/experience has been satisfactorily completed and that the individual has achieved a level of competency sufficient to independently operate a nuclear pharmacy.”</p> | <p>Date</p> |
|---|-------------|

*Purpose of Use

1. Shipping, receiving, and performing related radiation surveys
- 2 Using and performing checks for proper operation of dose calibrators, survey meters, and other instruments used to measure photon- and high energy beta- emitting radionuclides
- 3 Using and performing checks for proper operation of instruments used to measure alpha- and low energy beta- emitting radionuclides
- 4 Calculating, assaying, and safely preparing dosages for patients or human research subjects
- 5 Use of administrative controls to avoid mistakes in the administration of byproduct material
6. Use of procedures to prevent or minimize contamination and/or use of proper decontamination procedures

Appendix H: Typical Duties and Responsibilities

The RSO's duties and responsibilities include ensuring radiological safety and compliance with NRC and DOT regulations, and with the conditions of the license (see Figure H.1). Typically, these duties and responsibilities include ensuring that:

- General surveillance is provided over all activities involving radioactive material, including routine monitoring, special surveys, and responding to events.
- Incidents are responded to, investigated, and cause(s) and appropriate corrective action(s) are identified, and timely corrective action(s) are taken;
- Proper authorities are notified of incidents such as damage, fire, or theft;
- Corrective actions are developed, implemented, and documented when violations of regulations or license conditions or program weaknesses are identified;
- Immediate termination of all activities following any unsafe condition or activity that is found to be a threat to public health and safety;
- He or she is the primary source of radiation protection information for personnel at all levels of responsibility;
- All radiation workers are properly trained;
- Procedures for the safe use of radioactive materials are developed and implemented;
- The licensee's procedures and controls, based upon sound radiation protection principles, are periodically reviewed to ensure that occupational doses and doses to members of the public are as low as is reasonably achievable (ALARA). Documentation is maintained to demonstrate, by measurement or calculation, that the total effective dose equivalent to the individual member of the public likely to receive the highest dose from the licensed operation does not exceed the annual limit;
- Prospective evaluations are performed of occupational exposures, and those individuals likely to receive, in one year, a radiation dose in excess of 10% of the allowable limits are provided personnel monitoring devices;
- When necessary, personnel monitoring devices are used and exchanged at the proper intervals, and records of the results of such monitoring are maintained;
- The performance of fume hoods and gloveboxes used for volatile radioactive material work are monitored for proper operation;
- The receipt, opening, and delivery of all packages of radioactive material arriving at the nuclear pharmacy are overseen and coordinated;
- An inventory of all radioactive materials is maintained and the types and quantities of radionuclides at the facility are limited to the forms and amounts authorized by the license;
- Sealed sources are leak-tested at required intervals;
- There is effective management of the radioactive waste program, including effluent monitoring;
- Packaging and transport of radioactive material is in accordance with all applicable DOT requirements;
- An up-to-date license is maintained and amendment and renewal requests and notifications of new ANPs are submitted in a timely manner;
- Radiation safety program audits are performed at least annually and documented;
- He or she acts as liaison to the NRC; and

All required records are properly maintained.

Figure H.1 Typical Duties and Responsibilities of the RSO.

Appendix I: Suggested Commercial Radiopharmacy Audit Checklist

Note: All areas indicated in audit notes may not be applicable to every license and may not need to be addressed during each audit. For example, licensees do not need to address areas which do not apply to the licensee's activities and activities which have not occurred since the last audit need not be reviewed at the next audit.

| | | | |
|--------------------|------|--------------------|--|
| Date of This Audit | | Date of Last Audit | |
| Next Audit Date | | | |
| Auditor | Date | | |
| (Signature) | | (Signature) | |
| Management Review | | Date | |

Audit History

| | |
|----|--|
| A. | Last audit of this location conducted on (date) |
| B. | Were previous audits conducted at intervals not to exceed 12 months? [10 CFR 20.1101] |
| C. | Were records of previous audits maintained? [10 CFR 20.2102] |
| D. | Were any deficiencies identified during last two audits or two years, whichever is longer? |
| E. | Were corrective actions taken? (Look for repeated deficiencies.) |

Organization and Scope of Program

| | | |
|----|--|--|
| A. | If the mailing address or places of use changed, was the license amended? [10 CFR 30.34] | |
| B. | If ownership changed or bankruptcy filed, was NRC prior consent obtained or was NRC notified? [10 CFR 30.34] | |
| C. | Authorized Nuclear Pharmacists | |
| | 1. | New ANP since last audit? If so, does new ANP meet NRC training requirements? [10 CFR 32.72, 10 CFR 35.2, 10 CFR 35.980(b), 10 CFR 35.972] |

| | | |
|----|---|---|
| | 2. | If an individual began work as an ANP, was NRC notified within 30 days or was license amended? [10 CFR 32.72] |
| D. | Radiation Safety Officer | |
| | 1. | New RSO since last audit? If so, does new RSO meet NRC training requirements |
| | 2. | If the RSO was changed, was license amended? |
| | 3. | Is RSO fulfilling his/her duties? |
| | 4. | To whom does RSO report? |
| E. | Authorized Users | |
| | 1. | New AU since last audit? If so, does new AU meet NRC training requirements? |
| | 2. | If an AU was added, was license amended? |
| F. | If the designated contact person for NRC changed, was NRC notified? | |
| G. | Type and quantity of byproduct material | |
| | 1. | Does the license authorize all of the NRC regulated radionuclides possessed? |
| | 2. | Is actual possession of those radionuclides within the limits on the license? |

Facilities

| | |
|----|--|
| A. | Are facilities as described in NRC license application? |
| B. | If facilities have changed, has NRC license been amended |

Equipment and Instrumentation

| | |
|----|--|
| A. | Sufficient numbers of portable and fixed radiation monitors? |
| B. | Do survey meters meet the NRC's criteria? [10 CFR 20.1501] |
| C. | Are calibration records maintained? [10 CFR 20.2103(a)] |

| | |
|----|---|
| D. | Are there sufficient lead shields (L-block, etc.) for work with radionuclides? |
| E. | Are generators housed in separate room and/or properly shielded to keep doses ALARA? |
| F. | Are procedures established for identifying, evaluating and reporting safety component defects? [10 CFR 21.21] |
| G. | Dose Calibrators for Photon-emitters [10 CFR 32.72(c)] |
| | 1. Constancy, at least once each day prior to assay of patient dosages ($\pm 10\%$)? |
| | 2. Linearity, at installation and at required frequency ($\pm 10\%$)? |
| | 3. Geometry dependence, at installation ($\pm 10\%$)? |
| | 4. Accuracy, at installation and at required frequency ($\pm 10\%$)? |
| | 5. After repair, adjustment, or relocation of the dose calibrator, were appropriate tests above repeated? |
| H. | Dose Measurement Systems for Beta- and Alpha-emitters [10 CFR 32.72(c)] |
| | 1. Calibrated for each isotope used, with that isotope? |
| | 2. Constancy, at least once each day prior to assay of patient dosages ($\pm 10\%$)? |
| | 3. Geometry dependence, at installation ($\pm 10\%$)? |
| | 4. Accuracy, at installation and at required frequency ($\pm 10\%$)? |
| | 5. Linearity, at installation and at required frequency ($\pm 10\%$)? |
| | 6. After repair, adjustment, or relocation of the dose calibrator, were appropriate tests above repeated? |

Area Surveys and Contamination Control [10 CFR 20.1501]

| | |
|----|--|
| A. | Are area surveys being performed at applicable locations and required frequencies? Records maintained? [10 CFR 20.2103] |
| B. | Are removable contamination surveys being performed at applicable locations and required frequencies? Records maintained? [10 CFR 20.2103] |
| C. | Is appropriate corrective action taken and documented when excess radiation or contamination levels are detected? |

Leak Tests

| | |
|----|---|
| A. | Was each sealed source leak tested every six months or at other prescribed intervals? |
| B. | Was the leak test performed according to the license? |
| C. | Are records of results retained with the appropriate information included? |
| D. | Were any sources found leaking and if yes, was NRC notified? |

Sealed Source Inventory

| | |
|----|--|
| A. | Is a record kept showing the receipt of each sealed source? [10 CFR 30.51(a)(1)] |
| B. | Are all sealed sources physically inventoried every six months? |
| C. | Are records of inventory results with appropriate information maintained? |

Training and Instructions to Workers

| | |
|----|--|
| A. | Were all workers who are likely to exceed 1 mSv (100 mrem) in a year instructed per [10 CFR 19.12]? Refresher training provided, as needed? [10 CFR 19.12] Records maintained? |
| B. | Were other workers trained as needed (e.g., radiopharmacy technicians, authorized users, couriers/drivers, ancillary personnel)? [10 CFR 30.33] Records maintained? |

| | |
|----|---|
| C. | Are workers knowledgeable of applicable 10 CFR Part 20 radiation protection procedures, emergency response procedures and license conditions? |
| D. | HAZMAT training provided, if required? [49 CFR 172.700, 49 CFR 172.701, 49 CFR 172.702, 49 CFR 172.703, 49 CFR 172.704] |

Material Use Control and Transfer

| | |
|----|--|
| A. | Are restricted and unrestricted areas delineated? |
| B. | Are radioactive materials that are stored in a controlled or unrestricted area secured from unauthorized access or removal? [10 CFR 20.1801] |
| C. | Are radioactive materials that are in a controlled or unrestricted area and not in storage controlled and maintained under constant surveillance? [10 CFR 20.1802] |
| D. | Procedures for receiving and opening packages? [10 CFR 20.1906] |
| E. | Transfer of byproduct material only to authorized recipients? [10 CFR 30.41, 10 CFR 32.71, 10 CFR 32.72, 10 CFR 32.74] |
| F. | Records of receipt and transfer? [10 CFR 30.51] |

Personnel Radiation Protection

| | |
|----|---|
| A. | Are ALARA considerations incorporated into the radiation protection program? [10 CFR 20.1101(b)] |
| B. | Were prospective evaluations performed showing that unmonitored individuals receive $\leq 10\%$ of limit? [10 CFR 20.1502(a)] |
| C. | Did unmonitored individuals' activities change during the year which could put them over 10% of limit? |
| D. | If yes to c. above, was a new evaluation performed? |
| E. | Is external dosimetry required (individuals likely to receive $>10\%$ of limit,)? And is dosimetry provided to these individuals? |

| | | |
|----|----|--|
| | 1. | Is the dosimetry supplier NVLAP approved? [10 CFR 20.1501(c)] |
| | 2. | Are the dosimeters exchanged at appropriate frequency? |
| | 3. | Are dosimetry reports reviewed by the RSO when they are received? |
| | 4. | Are the records on NRC Forms or equivalent? [10 CFR 20.2104(d), 10 CFR 20.2106(c)] |
| | a. | NRC-Form 4 “Cumulative Occupational Exposure History” completed? |
| | b. | NRC-Form 5 “Occupational Exposure Record for a Monitoring Period” completed? |
| | 5. | Declared pregnant worker/embryo/fetus |
| | a. | If a worker declared her pregnancy, did licensee comply with [10 CFR 20.1208]? |
| | b. | Were records kept of embryo/fetus dose per [10 CFR 20.2106(e)]? |
| F. | | Monitoring for internal dose if individuals likely to receive >10% of ALI? |
| G. | | Are workers notified annually of their exposures? |
| H. | | Are records of exposures, surveys, monitoring, and evaluations maintained [10 CFR 20.2102, 10 CFR 20.2103, 0 CFR 20.2106 |

Waste Management

| | | |
|----|---------------------|---|
| A. | Waste storage areas | |
| | 1. | Is storage area properly posted? [10 CFR 20.1902] |
| | 2. | Are containers properly labeled? [10 CFR 20.1904] |
| B. | Decay-in-Storage | |
| | 1. | Do radionuclides being stored all have half-lives less than 120 days? |

| | | |
|----|---|--|
| | 2. | Are radionuclides being segregated for storage according to half-life? |
| | 3. | Each radionuclide in radioactive waste stored for a minimum of 10 half-lives? |
| | 4. | Before waste is disposed of: |
| | a. | Survey performed at the container surface with an appropriate survey instrument set on its most sensitive scale with no interposed shielding to determine that its radioactivity cannot be distinguished from background? |
| | b. | All radiation labels removed or obliterated, as appropriate? |
| | 5. | Record Keeping? |
| C. | Disposal by release into sanitary sewerage. | |
| | 1. | Is licensed material readily soluble (or readily dispersible biologically material) in water? [IN 94-07] Solubility Criteria for Liquid Effluent Releases to Sanitary Sewerage Under the Revised 10 CFR Part 20. [10 CFR 20.2003] |
| | 2. | Quantity of licensed material that the licensee releases into the sewer each month averaged over the monthly volume of water released into the sewer does not exceed the concentration specified in 10 CFR Part 20, Appendix B, Table 3? |
| | 3. | If more than one radioisotope is released, the sum of the ratios of the average monthly discharge of a radioisotope to the corresponding limit in 10 CFR Part 20, Appendix B, Table 3 does not exceed unity? |
| | 4. | Total quantity of licensed material released into the sanitary sewerage system in a year does not exceed the limits specified in 10 CFR 20.2003(a)(4)? |
| D. | Transfer to Authorized Recipient | |

| | | |
|--|----|---|
| | 1. | Waste being transferred to a person specifically authorized to receive it? [10 CFR 20.2001] |
| | 2. | Waste properly manifested? [10 CFR 20.2006] |

Receipt of Radioactive Waste from Customers

| | |
|----|--|
| A. | Waste returned consists only of items that contained radioactive materials that the radiopharmacy supplied (e.g. pharmacy supplied syringes, vials)? |
| B. | Waste package checked for removable contamination upon receipt? |

Effluents

| | |
|----|--|
| A. | Effluents from materials being maintained As Low As Reasonably Achievable (ALARA)? |
| B. | Fume hoods checked to confirm an adequate airflow? |
| C. | Effluent monitored to determine activity being released? |
| D. | Filters being maintained according to the manufacturer's instructions and pharmacy procedures? |

Public Dose

| | |
|----|---|
| A. | Public access to radioactive materials and exposure to effluents controlled in a manner to keep doses below 1 mSv (100 mrem) in a year? [10 CFR 20.1301(a)(1)] |
| B. | Air emissions maintained below constraint limit of 0.1 mSv (10 Millirem) in a year? [10 CFR 20.1101(d)] |
| C. | Survey or prospective evaluation performed per 10 CFR 20.1501(a)? Have there been any additions or changes to the storage, security, or use of surrounding areas that would necessitate a new survey or evaluation? |
| D. | Unrestricted area radiation levels exceed 0.02 mSv (2 mrem) in any one hour? [10 CFR 20.1301(a)(2)] |
| E. | Records maintained? [10 CFR 20.2103, 10 CFR 20.2107] |

Use and Emergency Procedures

| | | |
|----|--|--|
| A. | Procedures for safe use of radioactive materials and emergency procedures developed and implemented? | |
| B. | Do the procedures contain the required elements? | |
| C. | Radioactive materials being handled safely? | |
| D. | Staff wearing protective clothing and personnel monitors as appropriate? | |
| E. | Assistance coordinated with outside agencies for emergency response (e.g., fire department)? | |
| F. | Did any emergencies occur? | |
| | 1. | If so, were they handled properly? |
| | 2. | Were appropriate corrective actions taken? |
| | 3. | Was NRC notification or reporting required? [10 CFR 20.2201, 10 CFR 20.2202, 10 CFR 20.2203] |

Transportation

| | |
|----|---|
| A. | DOT-7A or other authorized packages used? [49 CFR 173.415, 49 CFR 173.416(b)] |
| B. | Package performance test records on file? |
| C. | Package has two labels (ex. Yellow-II) with TI, Nuclide, Activity, and Hazard Class? [49 CFR 172.403, 49 CFR 173.441] |
| D. | Package properly marked? [49 CFR 172.301, 49 CFR 172.304, 49 CFR 172.310, 49 CFR 172.324] |
| E. | Package closed and sealed during transport? [49 CFR 173.475(f)] |
| F. | Shipping papers prepared and used? [49 CFR 172.200(a)] |

| | |
|----|--|
| G. | Shipping papers contain proper entries? {Shipping name, Hazard Class, Identification Number (UN Number), Total Quantity, Package Type, Nuclide, RQ, Radioactive Material, Physical and Chemical Form, Activity (SI units required), category of label, TI, Shipper's Name, Certification and Signature, Emergency Response Phone Number, Emergency Response Information, and Cargo Aircraft Only (if applicable)} [49 CFR 172.200, 49 CFR 172.201, 49 CFR 172.202, 49 CFR 172.203, 49 CFR 172.204, 49 CFR 172.604] |
| H. | Shipping papers within drivers reach and readily accessible during transport? [49 CFR 177.817(e)]. |
| I. | Package secured against movement? [49 CFR 177.834] |
| J. | Any incidents reported to DOT? [49 CFR 171.15, 49 CFR 171.16] |

Auditor's Independent Survey Measurements (If Made)

| | |
|----|---|
| A. | Describe the type, location, and results of measurements. Does any radiation level exceed regulatory limits? [10 CFR 20.1501(a), 10 CFR 20.1502(a)] |
|----|---|

Notification and Reports

| | |
|----|--|
| A. | Was any radioactive material lost or stolen? Were reports made? [10 CFR 20.2201, 10 CFR 30.50] |
| B. | Did any reportable incidents occur? Were reports made? [10 CFR 20.2202, 10 CFR 30.50] |
| C. | Did any overexposures and high radiation levels occur? Reported? [10 CFR 20.2203, 10 CFR 30.50] |
| D. | Were any contaminated packages or packages with surface radiation levels exceeding 200 mrem received? Reported to NRC? |

| | |
|----|---|
| E. | If any events (as described in items A through D above) did occur, what was root cause? Were appropriate notifications made and corrective actions taken? |
| F. | Is the management/RSO aware of telephone number for NRC Emergency Operations Center? [(301) 816-51 |

Posting and Labeling

| | |
|----|---|
| A. | NRC-Form 3 "Notice to Workers" posted? [10 CFR 19.11] |
| B. | NRC regulations, license documents posted or a notice posted? [10 CFR 19.11, 10 CFR 21.6; Section 206 of Energy Reorganization Act of 1974] |
| C. | Other posting and labeling? [10 CFR 20.1902, 10 CFR 20.1904] |

Record Keeping for Decommissioning

| | |
|----|---|
| A. | Records kept of information important to decommissioning? [10 CFR 30.35(g)] |
| B. | Records include all information outlined in 10 CFR 30.35(g) |

Bulletins and Information Notices

| | |
|----|---|
| A. | NRC Bulletins, NRC Information Notices, NMSS Newsletters, received? |
| B. | Appropriate training and action taken in response? |

Special License Conditions or Issues

| | |
|----|---|
| A. | Did auditor review special license conditions or other issues |
|----|---|

Deficiencies Identified in Audit; Corrective Actions

| | |
|----|---|
| A. | Summarize problems/deficiencies identified during audit. |
| B. | If problems/deficiencies identified in this audit, describe corrective actions planned or taken by the facility. Include date(s) when corrective actions are implemented. |

| | |
|----|--|
| C. | Provide any other recommendations for improvement. |
|----|--|

Evaluation of Other Factors

| | |
|----|--|
| A. | Senior licensee management is appropriately involved with the radiation protection program and/or RSO oversight? |
| B. | RSO has sufficient time to perform his/her radiation safety duties? |
| C. | Licensee has sufficient staff to support the radiation protection program. |

Appendix J: Radiation Monitoring Instrument Specifications and Model Survey Instrument Calibration Program

The specifications in Table J.1 will help applicants and licensees choose the proper radiation detection equipment for monitoring the radiological conditions at their facility(ies).

Table J.1 Typical Survey Instruments¹ *Instruments used to measure radiological conditions at licensed facilities.*

| Portable Instruments Used for Contamination and Ambient Radiation Surveys | | | |
|--|------------------|---|-------------------|
| Detectors | Radiation | Energy Range | Efficiency |
| Exposure Rate Meters | Gamma, X-ray | mR-R | N/A |
| Count Rate Meters | | | |
| GM | Alpha | All energies (dependent on window thickness) | Moderate |
| | Beta | All energies (dependent on window thickness) | Moderate |
| | Gamma | All energies | <1% |
| NaI Scintillator | Gamma | All energies (dependent on crystal thickness) | Moderate |
| Plastic Scintillator | Beta | C-14 or higher (dependent on window thickness) | Moderate |

| Stationary Instruments Used to Measure Wipe, Bioassay, and Effluent Samples | | | |
|--|------------------|---------------------|-------------------|
| Detectors | Radiation | Energy Range | Efficiency |
| LSC* | Alpha | All energies | High |
| | Beta | All energies | High |

| Stationary Instruments Used to Measure Wipe, Bioassay, and Effluent Samples | | | |
|--|------------------|---------------------|-------------------|
| Detectors | Radiation | Energy Range | Efficiency |
| | Gamma | | Moderate |
| Gamma Counter (NaI)* | Gamma | All energies | High |
| Gas Proportional | Alpha | All energies | High |
| | Beta | All energies | Moderate |

| Stationary Instruments Used to Measure Wipe, Bioassay, and Effluent Samples | | | |
|--|------------------|---------------------|-------------------|
| Detectors | Radiation | Energy Range | Efficiency |
| | Gamma | All energies | <1% |

¹ Table from The Health Physics & Radiological Health Handbook, Revised Edition, Edited by Bernard Shleien, 1992 (except from * items)

Model Instrument Calibration Program

Training

Before allowing an individual to perform survey instrument calibrations, the RSO will ensure that he or she has sufficient training and experience to perform independent survey instrument calibrations.

Classroom training may be in the form of lecture, videotape, or self-study and will cover the following subject areas:

- Principles and practices of radiation protection;
- Radioactivity measurements, monitoring techniques, and using instruments;
- Mathematics and calculations basic to using and measuring radioactivity; and
- Biological effects of radiation.

Appropriate on-the-job-training consists of the following:

- Observing authorized personnel performing survey instrument calibration; and
- Conducting survey meter calibrations under the supervision and in the physical presence of an individual authorized to perform calibrations.

Facilities and Equipment for Calibration of Dose Rate or Exposure Rate Instruments

- To reduce doses received by individuals not calibrating instruments, calibrations will be conducted in an isolated area of the facility or at times when no one else is present;
- Individuals conducting calibrations will wear assigned dosimetry; and
- Individuals conducting calibrations will use a calibrated and operable survey instrument to ensure that unexpected changes in exposure rates are identified and corrected.

Model Procedure for Calibrating Survey Instruments

A radioactive sealed source(s) used for calibrating survey instruments will:

- Approximate a point source;
- Have its apparent source activity or the exposure rate at a given distance traceable by documented measurements to a standard certified to be within $\pm 5\%$ accuracy by National Institutes of Standards and Technology (NIST);
- Approximate the same energy and type of radiation as the environment in which the calibrated device will be employed; and

- For dose rate and exposure rate instruments, the source should be strong enough to give an exposure rate of at least about 7.7×10^{-6} coulombs/kilogram/hour (30 mR/hr) at 100 cm [e.g., 3.1 gigabecquerels (85 mCi) of cesium-137 or 7.8×10^2 megabecquerels (21 mCi) of cobalt-60.

The three kinds of scales frequently used on dose or dose rate survey meters are calibrated as follows⁽²⁾:

- Linear readout instruments with a single calibration control for all scales shall be adjusted at the point recommended by the manufacturer or at a point within the normal range of use. Instruments with calibration controls for each scale shall be adjusted on each scale. After adjustment, the response of the instrument shall be checked at approximately 20% and 80% of full scale. The instrument's readings shall be within $\pm 15\%$ of the conventionally true values for the lower point and $\pm 10\%$ for the upper point;
- Logarithmic readout instruments, which commonly have a single readout scale spanning several decades, normally have two or more adjustments. The instrument shall be adjusted for each scale according to site specifications or the manufacturer's specifications. After adjustment, calibration shall be checked at a minimum of one point on each decade. Instrument readings shall have a maximum deviation from the conventionally true value of no more than 10% of the full decade value;
- Meters with a digital display device shall be calibrated the same as meters with a linear scale;
- Readings above 2.58×10^{-4} coulomb/kilogram/hour (1 R/hr) need not be calibrated, but such scales should be checked for operation and response to radiation; and
- The inverse square and radioactive decay law should be used to correct changes in exposure rate due to changes in distance or source decay.

Surface Contamination Measurement Instruments²

- Survey meters' efficiency must be determined by using radiation sources with similar energies and types of radiation that the survey instrument will be used to measure.
- If each scale has a calibration potentiometer, the reading shall be adjusted to read the conventionally true value at approximately 80% of full scale, and the reading at approximately 20% of full scale shall be observed. If only one calibration potentiometer is available, the reading shall be adjusted at mid-scale on one of the scales, and readings on the other scales shall be observed. Readings shall be within 20% of the conventionally true value.

Model Procedures for Calibrating, Liquid Scintillation Counters, Gamma Counters, Gas Flow Proportional Counters, and Multichannel Analyzers

A radioactive sealed source used for calibrating instruments will do the following:

- Approximate the geometry of the samples to be analyzed;
- Have its apparent source activity traceable by documented measurements to a standard certified to be within $\pm 5\%$ accuracy by National Institutes of Standards and Technology (NIST); and
- Approximate the same energy and type of radiation as the samples that the calibrated device will be used to measure.

Calibration

- Calibration must produce readings within $\pm 20\%$ of the actual values over the range of the instrument.
- Calibration of liquid scintillation counters will include quench correction.

Calibration Records

Calibration reports, for all survey instruments, will indicate the procedure used and the data obtained. The description of the calibration will include:

- The owner or user of the instrument;
- A description of the instrument, including the manufacturer's name, model number, serial number, and type of detector;
- A description of the calibration source, including the exposure rate at a specified distance or activity on a specified date;
- For each calibration point, the calculated exposure rate or count rate, the indicated exposure rate or count rate, the deduced correction factor (the calculated exposure rate or count rate divided by the indicated exposure rate or count rate), and the scale selected on the instrument;
- For instruments with external detectors, the angle between the radiation flux field and the detector (i.e., parallel or perpendicular);
- For instruments with internal detectors, the angle between radiation flux field and a specified surface of the instrument;
- For detectors with removable shielding, an indication whether the shielding was in place or removed during the calibration procedure;
- The exposure rate or count rate from a check source, if used; and
- The name of the person who performed the calibration and the date it was performed.

The following information will be attached to the instrument as a calibration sticker or tag:

- For exposure rate meters, the source isotope used to calibrate the instrument (with correction factors) for each scale;
- The efficiency; of the instrument, for each isotope the instrument will be used to measure (if efficiency is not calculated before each use);
- For each scale or decade not calibrated, an indication that the scale or decade was checked only for function but not calibrated;
- The date of calibration and the next calibration due date; and
- The apparent exposure rate or count rate from the check source, if used.

Air Sampler Calibration

In order to assess accurately the air concentration of radioactive materials in a given location, the volume of air sampled and the quantity of contaminant in the sample must be determined. Accurate determination of the volume of air sampled requires standard, reproducible, and periodic calibration of the air metering devices that are used with air sampling instruments.

The publication entitled "Air Sampling Instruments" found in the 7th Edition, American Conference of Governmental Industrial Hygienists, 1989, provides guidance on total air sample volume calibration methods acceptable to NRC staff, as supplemented below.

Frequency of Calibration

- A licensee committed to a routine or emergency air sampling program should perform an acceptable calibration of all airflow or volume metering devices at least annually (see Regulatory Guide 8.25).
- Special calibrations should be performed at any time there is reason to believe that the operating characteristics of a metering device have been changed, by repair or alteration, or whenever system performance is observed to have changed significantly.
- Routine instrument maintenance should be performed as recommended by the manufacturer.
- Primary or secondary standard instruments used to calibrate air sampling instruments should be inspected frequently for consistency of performance.

Error Limit For Measurement of Air Sample Volume

Most methods of calibrating airflow or air volume metering devices require direct comparison to a primary or secondary standard instrument, to determine a calibration curve or a correction factor. An example of a primary standard is a spirometer that measures total air volume directly with high precision by liquid displacement. An example of a secondary standard is a wet-test meter that has been calibrated against a primary standard. Primary standards are usually accurate to within $\pm 1\%$ and secondary standards to within $\pm 2\%$.

The following are significant errors associated with determining the total air volume sampled:

| | |
|---------|--|
| E_C : | The error in determining the calibration factor. (An acceptable estimate is the percentage error associated with the standard instrument used in the calibration.) ⁽³⁾ |
| E_S : | Intrinsic error in reading the meter scale. (An acceptable estimate is the percentage equivalent of one-half of the smallest scale division, compared to the scale reading.) |
| E_t : | The percentage error in measurement of sampling time that should be kept within 1%. |
| E_V : | The most probable value of the cumulative percentage error in the determination of the total air volume sampled can be calculated from the following equation, provided there are no additional significant sources of errors: |

$$E_V = [E_S^2 + E_C^2 + E_t^2]^{1/2}$$

The most probable value of the cumulative error E_V , in the determination of total volume, should be less than 20%.

A sample calculation of the most probable value of the cumulative error in total volume measured is as follows: If accuracies of the scale reading, the calibration factor, and sample time

are ± 4, 2, and 1%, respectively, and there are no other significant sources of error, the cumulative error would be:

$$E_v = [4^2 + 2^2 + 1^2]^{1/2} = 4.58\% \text{ or approx. } 5\%$$

If there are significant differences in pressure and temperature between the calibration site and the sampling site, appropriate corrections should be made using the ideal gas laws provided below:

$$V_s = V_1 * (P_1/760) * (273/T_1)$$

where V_s = volume at standard conditions (760 mm & 0C)

V_1 = volume measured at conditions P_1 and T_1

T_1 = temperature of V_1 in K

P_1 = pressure of V_1 in mm Hg

Documentation of Calibration of Air Metering Devices

The licensee should maintain records of all routine and special calibrations of airflow or volume metering devices, including the primary or secondary standard used, method employed, and estimates of accuracy of the calibrated metering devices. All instruments should be clearly labeled as to the date and results of the most recent calibration and should include the appropriate correction factors to be used.

References: See the Notice of Availability on the inside front cover of this report to obtain a copy of:

| | |
|----|---|
| 1. | Draft Regulatory Guide FC 413-4, "Guide for the Preparation of Applications for Licenses for the Use of Radioactive Materials in Calibrating Radiation Survey and Monitoring Instruments," dated June 1985; |
| 2. | Regulatory Guide 8.25, Revision 1, "Air Sampling in the Workplace," dated June 1992; and |
| 3. | NUREG - 1400, "Air Sampling in the Workplace," dated September 1993. |

Additional References:

| | |
|----|--|
| 4. | The Health Physics & Radiological Health Handbook, Revised Edition, Edited by Bernard Shleien, dated 1992; |
| 5. | ANSI N323A-1997, "Radiation Protection Instrumentation Test and Calibration." Copies may be obtained from the American National Standards Institute, 1430 Broadway, New York, NY 10018 or ordered electronically at the following address: <www.ansi.org>; and |
| 6. | "Air Sampling Instruments," American Conference of Governmental Industrial Hygienists, 7th Edition, dated 1989. |

Appendix K: Public Dose

This Appendix describes different methods for determining radiation doses to members of the public.

Licensees must ensure that:

- The radiation doses received by individual members of the public do not exceed 1 millisievert (mSv) [100 millirem (mrem)] in one calendar year resulting from the licensee's possession and/or use of licensed materials. (10 CFR 20.1301);
- Air emissions of radioactive material to the environment will not result in exposures to individual members of the public in excess of 0.1 mSv (10 mrem) (TEDE) in one year from those emissions. (10 CFR 20.1101); and
- The radiation dose in unrestricted areas does not exceed 0.02 mSv (2 mrem) in any one hour. (10 CFR 20.1301)

Members of the public include persons who live, work, or may be near locations where byproduct material is used or stored and employees whose assigned duties do not include the use of byproduct material but may who work in the vicinity where such materials are used or stored.

| Doses to Members of the Public http://www.ansi.org | |
|--|--|
| INCLUDES doses from: | DOES NOT INCLUDE doses from: |
| • Radiation and/or radioactive material released by a licensee; | • Sanitary sewerage discharges from licensees; |

| | | | |
|---|---|---|--|
| • | Sources of radiation under the control of a licensee; and | • | Natural background radiation; |
| • | Air effluents from sources of licensed radioactive materials. | • | Medical administration of radioactive material; or |
| | | • | Voluntary participation in medical research. |

Typical unrestricted areas may include offices, shops, areas outside buildings, property, and storage areas. The licensee does not control access to these areas for purposes of controlling exposure to radiation or radioactive materials. However, the licensee may control access to these areas for other reasons such as security

The licensee may show compliance with the annual dose and constraint limits for individual members of the public by:

- Demonstrating by measurement or calculation that the TEDE to the individual like to receive the highest dose at the boundary of the unrestricted area does not exceed 1 mSv (100 mrem) from all exposure pathways, and does not exceed 0.1 mSv (10 mrem) from air emissions.; and
- Demonstrating that the annual average concentration of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area does not exceed the values specified in Table 2 of Appendix B to Part 20 (20% of the values for gaseous effluents); and if an individual were continuously present in an unrestricted area the dose from external sources would not exceed 0.02 mSv (2 mrem) in an hour and 0.5 mSv (0.05 rem) in a year.

In order to perform a dose assessment, the licensee should identify all potential sources of external and internal radiation exposure to members of the public and all locations of use, transport and storage of radioactive material at their facility. The licensee must then take radiation measurements or perform calculations to demonstrate compliance.

Measurements

The licensee may use measurements to demonstrate that the TEDE to the individual likely to receive the highest dose at the boundary of the unrestricted area does not exceed 1 mSv (100 mrem) and does not exceed 0.1 mSv (10 mrem) from air emissions. These measurements may include:

- Dose rate surveys for radiation exposures from external radiation sources; and
- Measurements of radionuclides in air and water effluent.

The method used to measure dose will depend upon the nature of the radiation source. If the source of radiation is constant, it may be adequate to measure the dose rate and integrate it over time. If the source of radiation differs or changes over time, it may be necessary to perform continuous measurements.

Radioactivity releases may be determined by effluent monitoring or by effluent sampling and analysis. At radiopharmacies, airborne effluents are discharged when potentially volatile materials are used, such as during iodine capsule preparation, but the discharge itself is usually not continuous since volatile materials are used periodically rather than continuously. Liquid effluents may be discharged continuously or may be stored and subsequently discharged on a batch basis. For each type of source and for each route of potential exposure, consider the location of measurement points, whether continuous or periodic monitoring is required, the frequency of sampling and measurement, and any additional information. For discharges of airborne radionuclides, for example, it may be necessary to obtain information on the efficiency of filters and the air flow rate of the discharge system, as well as meteorological data and the distance to the nearest individual member of the public.

Calculation Method

Using a calculation method, the licensee must determine the highest dose an individual is likely to receive at the boundary of the unrestricted area. The licensee must take into account the individual's exposure from external sources and the concentration of radionuclides in gaseous and liquid releases. In practice, the licensee may wish to make conservative assumptions to simplify the dose calculation.

The public dose limit applies to the individual who is likely to receive the highest dose from licensed operations, therefore, the dose calculations must consider the location with the potential for the highest internal and external exposures. This calculation should assume that the individual was continuously present 24 hours a day, 365 days a year, or an occupancy factor of 1 (see Table K.1). If the result of the calculation using an occupancy factor of 1 demonstrates that the public dose and constraint limits are not exceeded, then there is no need for further evaluation.

If the calculation demonstrates that either the public dose or constraint limit is exceeded with an occupancy factor of 1, then more realistic assumptions of the individual's occupancy at the points of highest internal and external exposures must be made. The licensee may use the occupancy factors in Table K.1 or may calculate a specific occupancy factor by determining the likely fraction of time that the individual is present.

Table K.1 Standard Occupancy Factors

| Occupancy Factor | Description |
|------------------|--|
| 1 | Work areas such as offices, laboratories, shops, and occupied space in nearby buildings or outdoor areas |
| 1/4 | Corridors, lounges, elevators using operators, unattended parking lots |

Figure K.1 Calculating Public Dose. *Steps to calculate the annual dose to an individual member of the public.*

Records

The licensee must maintain records to demonstrate compliance with the dose limit for individual members of the public, until the Commission terminates the license. In general, survey and monitoring records of ambient radiation and effluent radioactivity should be adequate.

Records demonstrating the dose to an individual member of the public should identify the instruments used in the survey, the name of the surveyor, the date of the survey, the location of the survey(s), including a description or drawing of the area surveyed, survey results, and, if applicable, the occupancy factors used and justification for their use. In addition, records demonstrating the dose to an individual member of the public that involve effluent sampling analysis should include information on concentrations of specific radionuclides, minimum detectable activity of the system and the estimated uncertainty of measurements.

Appendix L: Model Leak Test Program

Training

Before allowing an individual to perform leak testing, the licensee must ensure that he or she has sufficient classroom and on-the-job training to show competency in performing leak tests independently.

Classroom training may be in the form of lecture, videotape, or self-study and will cover the following subject areas:

- Principles and practices of radiation protection;
- Radioactivity measurements, monitoring techniques, and using instruments;
- Mathematics and calculations basic using and measuring radioactivity; and
- Biological effects of radiation.

Appropriate on-the-job-training consists of:

- Observing authorized personnel collecting and analyzing leak test samples; and
- Collecting and analyzing leak test samples under the supervision and in the physical presence of an individual authorized to perform leak tests

Facilities and Equipment

- To ensure achieving the required sensitivity of measurements, leak tests will be analyzed in a low-background area.
- Use a calibrated and operable survey instrument to check leak test samples for gross contamination before they are analyzed.
- Analyze the leak test sample using an instrument that is appropriate for the type of radiation to be measured (e.g., NaI(Tl) well counter system for gamma-emitters, liquid scintillation for beta-emitters, gas-flow proportional counters for alpha-emitters).
- If the sensitivity of the counting system is unknown, the minimum detectable activity (MDA) needs to be determined. The MDA may be determined using the following formula:

$$MDA = \frac{3 + 4.6 \sqrt{bkg}}{E \left(\frac{g}{t} \right)^{1/2}}$$

where: MDA = minimum detectable activity in disintegrations per minute (dpm)

bkg = background count rate in counts per minute (cpm)

t = background counting time in minutes

E = detector efficiency in counts per disintegration

For example:

where: bkg = 200 cpm

E = 10%, or 0.1

t = 2 minutes

$$\frac{M \pm DA}{50} = \frac{3 \pm 4.6}{20} \text{cpm/2 minutes} = (0.15 \pm 0.23) \text{cpm/2 minutes}$$

= 495 dpm

Frequency for Conducting Leak Tests of Sealed Sources

Leak tests will be conducted at the frequency specified in the respective SSD Registration Certificate.

Procedure for Performing Leak Testing and Analysis

- For each source to be tested, list identifying information such as sealed source serial number, radionuclide, activity.
- If available, use a survey meter to monitor exposure.
- Prepare a separate wipe sample (e.g., cotton swab or filter paper) for each source.
- Number each wipe to correlate with identifying information for each source.
- Wipe the most accessible area where contamination would accumulate if the sealed source were leaking.
- Select an instrument that is sensitive enough to detect 185 Bq (0.005 microcuries) of the radionuclide.
- Using the selected instrument, count and record background count rate.
- Check the instrument's counting efficiency using a standard source of the same radionuclide as the source being tested or one with similar energy characteristics. Accuracy of standards should be within $\pm 5\%$ of the stated value and traceable to primary radiation standard such as those maintained by the National Institutes of Standards and Technology (NIST).
- Calculate efficiency.

| | | |
|--------------|--|------------------------|
| For example: | $\frac{[(\text{cpm from std}) - (\text{cpm from bkg})]}{\text{activity of std in Bq}}$ | = efficiency in cpm/Bq |
|--------------|--|------------------------|

where: cpm = counts per minute

std = standard

bkg = background

Bq = becquerel

- Count each wipe sample; determine net count rate.
- For each sample, calculate and record estimated activity in Bq (or mCi).

| | | |
|--------------|---|------------------------|
| For example: | $\frac{[(\text{cpm from wipe sample}) - (\text{cpm from background})]}{\text{activity of std in Bq}}$ | = efficiency in cpm/Bq |
|--------------|---|------------------------|

- Sign and date the list of sources, data and calculations. Retain records for 3 years (10 CFR 20.2103(a)). If the wipe test activity is 185 Bq (0.005 microcurie) or greater, notify the RSO, so that the source can be withdrawn from use and disposed of properly. Also notify NRC.

Reference: See the Notice of Availability (on the inside front cover of this report) to obtain a copy of Draft RG FC 412-4, "Guide for the Preparation of Applications for Licenses for the Use of Radioactive Materials in Leak-Testing Services," dated June 1985.

Appendix M: Transportation DOT Regulations Applicable to Radiopharmacy Shipments

The major areas in the DOT regulations most relevant to commercial radiopharmacies for the transportation of radioactive material are:

- Hazardous Materials Table, 49 CFR 172.101, App. A, list of hazardous substances and reportable quantities (RQ), Table 2: Radionuclides.

For the majority of packages shipped by radiopharmacies to their customers, the proper shipping name to use will be "Radioactive Material, N.O.S." Other shipments, involving primarily small quantities of radioactive material, and especially return shipments by customers, will likely be excepted packages of limited quantity. The DOT requirements for those shipments can be found in 49 CFR 173.421 and 173.422.

Likewise, for the majority of packages shipped by radiopharmacies, it will not be necessary to identify the radioactive material as a Hazardous Substance in accordance with Table 2 of 49 CFR 172.101. For the majority of radionuclides contained in packages from radiopharmacies (i.e., technetium-99m and thallium-201) the threshold for identification as a Hazardous Substance is on the order of 100 to 1000 curies, which is significantly more than is contained in the typical shipment. However, for shipments containing more than 10 millicuries of iodine-131, the packages and shipping papers must include the "RQ" designation of the shipment as containing a reportable quantity. The "RQ" must appear either before or after the basic description of the shipment on the shipping papers (i.e., "RQ Radioactive Material, N.O.S., UN 2982") and must be included in the package markings (Ref. 49 CFR 172.203(c) and 49 CFR 172.324).

- Shipping Papers 49 CFR 172.200-204: General entries, description, additional description requirements, shipper's certification

For most packages likely to be shipped by commercial radiopharmacies shipping papers are required. These must include:

- proper shipping name (as described above);
- hazard class of the material; for radioactive materials, the hazard class is 7;
- identification number; for the proper shipping name, "Radioactive Material, N.O.S.," the identification number is UN 2982;
- package type, which will usually be Type A;
- name and quantity of each radionuclide in the shipment; the radionuclide may be abbreviated (i.e., Tc-99m);
- physical and chemical form of the radioactive material;
- category of label applied to each package in the shipment (i.e., "Radioactive White-I");
- transport index (TI) of each package bearing Radioactive Yellow-II or Radioactive Yellow-III labels;
- emergency response telephone number; and
- shipper's certification and signature.

Shipping papers may include additional information; however, the additional information must not detract from the required entries.

For most, if not all, return shipments of wastes from radiopharmacy customers, the packages can

be shipped as excepted packages (limited quantity of radioactive material) and will not require shipping papers; however, such shipments must include a statement on, in, or transported with, the package. The statement is contained in 49 CFR 173.422(a)(1), and must be verbatim.

Although the proper preparation of the package of returned waste is the responsibility of the shipper (i.e., the customer), radiopharmacies should be aware of the specific requirements if they intend to provide guidance to their customers regarding these types of shipments.

- Package Markings 49 CFR 172.300, 49 CFR 172.301, 49 CFR 172.303, 49 CFR 172.304, 49 CFR 172.310, 49 CFR 172.324: General marking requirements for non-bulk packaging, prohibited marking, marking requirements, radioactive material, hazardous substances in non-bulk packaging

All certification packages shipped by commercial radiopharmacies (i.e., Type A packages) must be properly marked, as follows:

- proper shipping name and identification number (i.e., "Radioactive Material, N.O.S., UN 2982");
- the letters RQ if the packages contain a hazardous substance, which will only likely occur when the packages contain more than 10 millicuries of iodine-131; and
- the designation Type A, if the package conforms to the Type A requirements.

DOT also specifies the size and appearance of the markings and markings that are prohibited.

- Package Labeling 49 CFR 172.400, 49 CFR 172.401, 49 CFR 172.403, 49 CFR 172.406, 49 CFR 172.407, 49 CFR 172.436, 49 CFR 172.438, 49 CFR 172.440: General labeling requirements, prohibited labeling, radioactive materials, placement of labels, specifications for radioactive labels.

All packages routinely prepared and shipped by commercial radiopharmacies are required to be labeled in accordance with DOT regulations. The labels will usually be either "Radioactive White-I," or "Radioactive Yellow-II." Radiopharmacies have rarely offered a package labeled as "Radioactive Yellow-III" for shipment. Packages exhibiting surface radiation levels equal to or less than 0.5 millirem per hour will be labeled as "Radioactive White-I." There is no TI, defined as a unitless number equivalent to the radiation level, in millirems per hour, at one meter from the surface of the package, for a White-I label. Packages with surface radiation levels greater than 0.5 millirem per hour, but less than or equal to 50 millirems per hour, will be labeled with a Yellow-II label. The TI for a Yellow-II label must be less than or equal to "1." The lowest TI is "0.1," and all TIs are rounded to the nearest tenth.

Packages required to be labeled must have two labels affixed, on opposite sides, but not on the top or bottom. The labels must include the identity and quantity of the radionuclides in the package. Yellow-II and Yellow-III labels must also include the TI. A label may not be affixed to a package that does not meet the applicable labeling requirements.

- Placarding of Vehicles 49 CFR 172.500, 49 CFR 172.502, 49 CFR 172.504, 49 CFR 172.506, 49 CFR 172.516, 49 CFR 172.519, 49 CFR 172.556: Applicability, prohibited and permissive placarding, general placarding requirements, providing and affixing placards: highway, visibility and display of placards, specifications for RADIOACTIVE placards.

DOT regulations specify when vehicles carrying hazardous materials must be placarded. For radiopharmacy shipments, this is usually applicable only when packages with Yellow-III labels affixed are offered or transported. Since commercial radiopharmacies rarely, if ever, offer Yellow-III packages for transport, placarding of the vehicles is not of concern and will not be discussed in detail.

- Emergency Response Information, Subpart G, 49 CFR 172.600, 49 CFR 172.602, 49 CFR 172.604: Applicability and general requirements, emergency response information, emergency response telephone number.

Persons who offer hazardous materials for transport, including radioactive materials, must provide or make available emergency response information, including:

- An emergency response telephone number must be included on the shipping papers and the number must be monitored at all times that the material is being transported. The person monitoring the telephone number must be either knowledgeable of the hazardous material being shipped or have comprehensive emergency response and incident mitigation information for that material, or have immediate access to a person who has such knowledge and information; and
- Emergency response information for the shipment that will aid emergency responders in mitigating the consequences of an accident, including the health hazards of the material, handling fires and spills involving the material, and first aid measures must be included on, or with, the shipping papers.

Applicants and licensees should review the specific DOT requirements applicable to emergency response information in the development of their programs and procedures.

- Training, Subpart H, 49 CFR 172.700, 49 CFR 172.702; and 49 CFR 172.704: Purpose and Scope; applicability and responsibility for training and testing, training requirements.

Licensees who prepare packages of radioactive materials and who transport their own packages must provide training to their employees who perform those functions. The training must include:

- General awareness and familiarization training designed to provide familiarity with DOT requirements, and enable the employee to recognize and identify hazardous materials;
- Function-specific training concerning the DOT requirements which are specifically applicable to the functions the employee performs (i.e., if the employee's duties require him/her to affix DOT Radioactive labels to packages, he or she must receive training in DOT's regulations governing package labeling); and
- Safety training concerning emergency response information, discussed above; measures to protect the employee and other employees from the hazards associated with the hazardous materials to which they may be exposed in the workplace; and methods of avoiding accidents, such as the proper procedures for handling packages containing hazardous materials.

The training must be provided initially, and then every three years. Records of training must be maintained.

- Shippers - General Requirements for Shipments and Packaging, Subpart I, 49 CFR 173.403, 49 CFR 173.410, 49 CFR 173.412, 49 CFR 173.415, 49 CFR 173.431, 49 CFR 173.433,

49 CFR 173.435, 49 CFR 173.441, 49 CFR 173.443, 49 CFR 173.448, 49 CFR 173.475: Definitions, general design requirements, additional design requirements for Type A packages, authorized Type A packages, activity limits for Type A... packages, requirements for determining A_1 and A_2 ..., table of A_1 and A_2 values for radionuclides, radiation level limitations, contamination control, general transportation requirements, quality control requirements prior to each shipment.

Package Activity Limits

Before offering a radioactive materials package for transport, the shipper must determine the category of the shipment. Licensees will likely prepare or transport two categories of packages containing radioactive material. The categories are based, in part, on the activity of the radioactive material contained in the package. The categories, activity ranges, packaging requirements, and examples are provided in Table M.1. All quantities referenced here are multiples of the A_2 (normal form) values specified for radionuclides in 49 CFR 173.435, and the physical form is assumed to always be liquid.

Table M.1 Package Activity Limits

| Category | Activity Range | Packaging Requirements | Example |
|---|--|---|---|
| Excepted packages, limited quantity of radioactive material | Less than $10^{-4} A_2$ | 49 CFR 173.421 and 173.422 | Less than 21.6 millicuries of technetium-99m (usually for returned waste shipments) |
| Radioactive Material, N.O.S. | Greater than $10^{-4} A_2$ but less than A_2 | Type A packaging (49 CFR 173.410; 49 CFR 173.412; 49 CFR 173.415; 49 CFR 173.431; 49 CFR 173.433) | More than 21.6 millicuries, but less than 216 curies of technetium-99m |

Once the quantity of material in the package has been determined, the appropriate packaging must be selected.

Packaging Design

Packages of radioactive material offered as excepted packages, limited quantity of radioactive material, in accordance with 49 CFR 173.421, are required to meet the minimum packaging requirements of 49 CFR 173.410. Those requirements primarily address, but are not limited to,

maintaining package integrity and contents during conditions normally expected to occur during transport. This does not include survival during accidents. Packaging normally used by commercial radiopharmacies (i.e., military ammunition boxes, “briefcases,” and cardboard/fiberboard boxes, typically meet and exceed those minimal requirements).

Packages containing “Type A” quantities must meet more stringent criteria, including testing to demonstrate that the packages will maintain their integrity of containment and shielding during normal conditions of transport. The testing criteria for Type A packages are listed in 49 CFR 173.465. Before offering a Type A package for shipment, the shipper is responsible for ensuring that the package has been tested to meet the criteria for the contents and the configuration to be shipped and maintaining a certificate of testing. Shippers are not required to personally test the packages, only to ensure that the testing was performed before use.

Quality Control

Prior to each shipment, the shipper is required to determine that the package is in condition for shipment. The determinations must include, but are not limited to verification of the following:

- Package is proper for the contents to be shipped;
- Packaging is in unimpaired physical condition; and
- External radiation and contamination levels are within the allowable limits.

The quality control requirements for radioactive material packages are located in 49 CFR 173.475.

The external radiation and contamination level limits are located in 49 CFR 173.441 and 173.443. The applicant should ensure that its procedures for preparing radioactive material packages include provisions to survey the handle on ammunition boxes and briefcases used as packaging, in addition to the closure clasp on ammunition boxes. Excessive contamination has been identified in those locations in several package contamination events reported to NRC in the past.

Carriage by Public Highway - General Information and Regulations, Subpart A, 49 CFR 177.816, 49 CFR 177.817, 49 CFR 177.834, 49 CFR 177.842: Driver training, shipping paper, general requirements (secured against movement), Class 7 (radioactive) material.

Licensees who intend to transport their own packages must ensure that their drivers receive training in the safe operation of the vehicle transporting the hazardous material packages. The training requirements include, but are not limited to:

- Pre-trip safety inspection of the vehicle;
- Requirements pertaining to vehicle attendance and incident reporting; and
- Loading and unloading of the materials, including blocking and bracing the packages and separation from occupied compartments.

The specific training requirements are located in 49 CFR 177.816.

The licensee must also ensure that its drivers maintain the shipping papers accessible during transport and when the driver is not at the vehicle controls. During transport, the shipping papers must be located within the driver's reach while restrained by the lap belt — either in a pocket in the driver's door of the vehicle or readily visible to someone entering the driver's compartment. In an accident, emergency responders are instructed to look in those locations for the shipping papers to aid in handling the hazardous material aspects, if any. Failure to properly locate shipping papers could adversely impact the response to an accident, result in actions that spread radioactive contamination, and result in unnecessary radiation exposures to the responders. When the driver is not at the vehicle controls, such as during deliveries to customers, the shipping papers for the packages remaining in the vehicle must be either in the pocket in the driver's side door or on the driver's seat in the vehicle.

49 CFR 177.834(a) and 177.842 require that packages of radioactive materials be blocked and braced so that they cannot change position during conditions normally incident to transportation. The method used must prevent lateral movement of the packages during normal transport conditions (turns, curves, potholes, dips, stopping and acceleration, etc.). This does not include accident situations. The key test for evaluating the effectiveness of blocking and bracing is to attempt to move the package by hand after it is loaded. If the package can be moved through normal (non-Herculean) effort, then it is not properly blocked and braced. The use of a non-skid material on the vehicle surface where the package is loaded is not sufficient by itself. Additional means are necessary to block the package within the vehicle.

Appendix N: Model Personnel Training Program

Training Program

| | | |
|-----|---|--|
| 1. | General instructions | |
| 1.1 | Training will be provided: <ul style="list-style-type: none"> • Before an employee assumes duties with or in the immediate vicinity of radioactive materials; • At least annually, as refresher training for all employees; and • Whenever a significant change occurs in duties, regulations, or the terms of the NRC licens | |
| 1.2 | Subjects covered for individuals working with, or in the vicinity of, radioactive materials or radiation: <ul style="list-style-type: none"> • Safe radiation practices associated with the job (examples of topics that may be covered are found in Section 3 of this Appendix); • Site-specific radiation safety practices; and • applicable NRC regulations. | |
| 1.3 | Subjects covered for ancillary personnel: <ul style="list-style-type: none"> • Significance of the radiation symbol and its use on signs and labels; • Location of unrestricted areas; and • Whether the individual is authorized access to the restricted areas of the pharmacy. | |
| 1.4 | Type of instruction: <ul style="list-style-type: none"> • Instruction in the licensee's site-specific radiation safety program and NRC regulatory requirements may be in the form of lecture, demonstrations, videotape, or self-study, and should emphasize practical subjects important to the safe use of licensed material; and • Individuals receiving instructions should be provided an opportunity to ask questions | |
| 2. | Instruction for individuals likely to receive an occupational dose in excess of 100 mSv (100 mrem) | |
| 2.1 | Instruction will be provided: <ul style="list-style-type: none"> • Before an employee assumes duties with or in the immediate vicinity of radioactive materials; • At least annually, as refresher training; and | |

| | |
|-----|--|
| | <ul style="list-style-type: none"> Whenever a significant change occurs in duties, regulations, or terms of the NRC license. |
| 2.2 | Licensee must provide instruction in subjects covered in 10 CFR 19.12. |
| 2.3 | Records of initial and refresher training should be maintained and should include: |
| | <ul style="list-style-type: none"> Name of the individual who provided the instruction; Names of the individuals who received the instruction; and Date of instruction List of the topics covered. |
| 3. | Suggested radiation safety training topics for individuals working with, or in the vicinity of, byproduct material (this section is intended as a guide to topics covered in a typical radiation safety training program; topics selected should be commensurate with the individuals' duties). |
| 3.1 | Basic radiation safety information: |
| | <ul style="list-style-type: none"> Basic radiation biology (e.g., interaction of ionizing radiation with cells and tissues); Radiation safety <ul style="list-style-type: none"> radiation vs. contamination; internal vs. external exposure; biological effects of radiation; ALARA concept; and use of time, distance, and shielding to minimize exposure; Risk estimates, including comparison with other health risks (10 CFR 19.12); Regulatory requirements <ul style="list-style-type: none"> RSO; material control and accountability; dose to individual members of the public; personnel dosimetry; |

| | | | |
|-----|---|---|---|
| | | --- | occupational dose limits and their significance; |
| | | --- | dose limits to the embryo/fetus, including instruction on declaration of pregnancy; |
| | | --- | workers' right to be informed of occupational radiation exposure; |
| | | --- | radiation safety program audits; |
| | | --- | ordering and receipt of packages; |
| | | --- | transfer; |
| | | --- | waste disposal; |
| | | --- | recordkeeping; |
| | | --- | surveys; |
| | | --- | postings; |
| | | --- | labeling of containers; |
| | | --- | handling and reporting of incidents or events; |
| | | --- | licensing and inspection by NRC; |
| | | --- | need for complete and accurate information; |
| | | --- | employee protection; and |
| | | --- | deliberate misconduct. |
| 3.2 | General topics for safe use of radioisotopes: | | |
| | • | Wear a laboratory coat or other protective clothing at all times when working with radioactive materials; | |
| | • | Use syringe shields and vial shields when preparing and handling radioactive drugs; | |
| | • | Measure all radiopharmaceuticals prior to transfer; | |

| | | |
|-----|---|--|
| | • | Measure the molybdenum-99 content of each generator elution and do not transfer those radiopharmaceuticals for human medical use that will contain more than 0.15microcuries of molybdenum-99 per mCi of technetium-99m at the time of administration; |
| | • | Wear disposable gloves at all times when handling radioactive materials and change gloves frequently to minimize the spread of contamination; |
| | • | Before leaving the hot lab, monitor hands, shoes, and clothing for contamination in a low-background area, allowing sufficient time for instrument response; |
| | • | Do not eat, drink, smoke, or apply cosmetics in any area where licensed material is stored or used; |
| | • | Do not store food, drink, or personal effects in areas where licensed material is stored or used (see Figure P.1). Personal items brought into the restricted area (i.e., radios, compact discs, notepads, books, etc.) should be surveyed for contamination before removal from the area; |
| | • | Food and beverages used in the preparation of radiopharmaceuticals should be clearly labeled “Not for personal consumption” if stored with radioactive materials; |
| | • | Wear personnel monitoring devices, if required, at all times while in areas where licensed materials are used or stored; |
| | • | Dispose of radioactive waste only in designated, labeled and properly shielded receptacles; |
| | • | Never pipette by mouth; |
| | • | Store radioactive solutions in clearly labeled containers; and |
| | • | Secure all licensed material when it is not under the constant surveillance and immediate control of the user(s). |
| 3.3 | | Instruction on radiopharmacy-specific program elements: |
| | • | Applicable regulations and license conditions; |

| | |
|---|--|
| • | Areas where radioactive material is used or stored; |
| • | Potential hazards associated with radioactive material in each area where the individuals will work; |
| • | Special procedures for handling volatile materials; |
| • | Proper use of radiation shielding; |
| • | Proper use of survey and analytical instruments; |
| • | Appropriate response to spills, emergencies or other unsafe conditions; |
| • | Emergency procedures; |
| • | Previous incidents, events and/or accidents; |
| • | Survey program; |
| • | Effluent monitoring and control; |
| • | Customer-returned waste pickup, receipt, and handling; |
| • | Waste management and minimization; |
| • | Personnel monitoring; |
| • | Procedures for receiving packages containing radioactive materials; |
| • | Procedures for opening packages; |
| • | Sealed sources and leak tests; and |
| • | Other topics, as applicable. |

Appendix O: Model Dose Calibrator Testing Program

Model Procedures for Testing Dose Calibrators Used to Measure Photon-emitting Radionuclides

This model procedure can be used by applicants and licensees for checking and testing dose calibrators.

| Model Procedure | |
|------------------------------|---|
| 1. | Test for the following at the indicated frequency. Consider repair, replacement, or arithmetic correction if the dose calibrator falls outside the suggested tolerances. |
| 1.1 | Constancy, at least once each day prior to assay of patient dosages (a safe margin is considered to be below $\pm 10\%$). |
| 1.2 | Linearity at installation and at least quarterly thereafter (a safe margin is considered to be below $\pm 10\%$). |
| 1.3 | Geometry dependence at installation (a safe margin is considered to be below $\pm 10\%$). |
| 1.4 | Accuracy, at installation and at least annually thereafter (a safe margin is considered to be below $\pm 10\%$). |
| 2. | After repair, adjustment, or relocation of the dose calibrator, such that proper function of the ionization chamber or electronics would likely be in doubt, repeat the above tests as appropriate. |
| 3. | Constancy means reproducibility in measuring a constant source over a long period of time. Assay at least one relatively long-lived source such as cesium-137, cobalt-60, cobalt-57, or radium-226 using a reproducible geometry each day before using the calibrator; however, cobalt-57 and radium-226 are not subject to NRC licensing; the appropriate State agency should be consulted to determine its requirements for possessing this material. Consider using two or more sources with different photon energies and activities. |
| Use the following procedure: | |
| 3.1 | Assay each reference source using the appropriate dose calibrator setting (i.e., use the cesium-137 setting to assay cesium-137). |
| 3.2 | Measure background at the same setting, and subtract or confirm the proper operation of the automatic background circuit if it is used. |
| 3.3 | For each source used either plot or log (i.e., record in the dose calibrator log book) the background level for each setting checked and the net activity of each constancy source. |