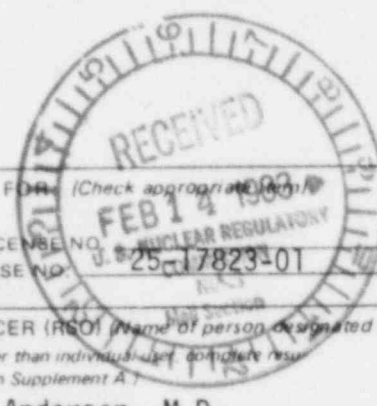


NRC FORM 313M (9-81) 10 CFR 35	U.S. NUCLEAR REGULATORY COMMISSION APPLICATION FOR MATERIALS LICENSE – MEDICAL	Approved by OMB 3150-0041 Expires 9-30-83
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INSTRUCTIONS – Complete Items 1 through 26 if this is an initial application or an application for renewal of a license. Use supplemental sheets where necessary. Item 26 must be completed on all applications and signed. Retain one copy. Submit original and one copy of entire application to: Director, Office of Nuclear Materials Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555. Upon approval of this application, the applicant will receive a Materials License. An NRC Materials License is issued in accordance with the general requirements contained in Title 10, Code of Federal Regulations, Part 30, and the Licensee is subject to Title 10, Code of Federal Regulations, Parts 19, 20 and 35 and the license fee provision of Title 10, Code of Federal Regulations, Part 170. The license fee category should be stated in Item 26 and the appropriate fee enclosed.

1.a. NAME AND MAILING ADDRESS OF APPLICANT (institution, firm, clinic, physician, etc.) INCLUDE ZIP CODE Marcus Daly Memorial Hospital Radiology Department 1200 Westwood Drive Hamilton, Montana 59840 TELEPHONE NO.: AREA CODE () _____	1.b. STREET ADDRESS(ES) AT WHICH RADIOACTIVE MATERIAL WILL BE USED (if different from 1.a.) INCLUDE ZIP CODE 
---	---

2. PERSON TO CONTACT REGARDING THIS APPLICATION Richard C. Atkins, Administrator TELEPHONE NO.: AREA CODE (406) 363 2211	3. THIS IS AN APPLICATION FOR (Check appropriate item) a. <input type="checkbox"/> NEW LICENSE b. <input type="checkbox"/> AMENDMENT TO LICENSE NO. _____ c. <input checked="" type="checkbox"/> RENEWAL OF LICENSE NO. 25-17823-01
--	--

4. INDIVIDUAL USERS (Name individuals who will use or directly supervise use of radioactive material. Complete Supplements A and B for each individual.) See Item 8 on page 7	5. RADIATION SAFETY OFFICER (RSO) (Name of person designated as radiation safety officer. If other than individual user, complete resume of training and experience as in Supplement A.) Paul Wm. Anderson, M.D.
--	---

(To designate a new RSO, follow the instructions in Item 8.b. on page 5 of Regulatory Guide 10.8.)

6.a. RADIOACTIVE MATERIAL FOR MEDICAL USE

RADIOACTIVE MATERIAL LISTED IN:	ITEMS DESIRED "X"	MAXIMUM POSSESSION LIMITS (In millicuries)	ADDITIONAL ITEMS:	MARK ITEMS DESIRED "X"	MAXIMUM POSSESSION LIMITS (In millicuries)
10 CFR 31.11 FOR IN VITRO STUDIES	N/A		IODINE-131 AS IODIDE FOR TREATMENT OF HYPERTHYROIDISM	X	10
10 CFR 35.100, SCHEDULE A, GROUP I	X	AS NEEDED	PHOSPHORUS-32 AS SOLUBLE PHOSPHATE FOR TREATMENT OF POLYCYTHEMIA VERA, LEUKEMIA AND BONE METASTASES	N/A	
10 CFR 35.100, SCHEDULE A, GROUP II	X	AS NEEDED	PHOSPHORUS-32 AS COLLOIDAL CHROMIC PHOSPHATE FOR INTRACAVITARY TREATMENT OF MALIGNANT EFFUSIONS.	N/A	
10 CFR 35.100, SCHEDULE A, GROUP III	X	2000	GOLD-198 AS COLLOID FOR INTRACAVITARY TREATMENT OF MALIGNANT EFFUSIONS.	N/A	
10 CFR 35.100, SCHEDULE A, GROUP IV	X	AS NEEDED	IODINE-131 AS IODIDE FOR TREATMENT OF THYROID CARCINOMA	N/A	
10 CFR 35.100, SCHEDULE A, GROUP V	N/A	AS NEEDED	XENON-133 AS GAS OR GAS IN SALINE FOR BLOOD FLOW STUDIES AND PULMONARY FUNCTION STUDIES	N/A	
10 CFR 35.100, SCHEDULE A, GROUP VI	N/A				

6.b. RADIOACTIVE MATERIAL FOR USES NOT LISTED IN ITEM 6.a. (Sealed sources up to 3 mCi used for calibration and reference standards are authorized under Section 35.14(d), 10 CFR Part 35, and NEED NOT BE LISTED.)

ELEMENT AND MASS NUMBER	CHEMICAL AND/OR PHYSICAL FORM	MAXIMUM NUMBER OF MILLICURIES OF EACH FORM	DESCRIBE PURPOSE OF USE
8507170601 850618 REG4 LIC30 25-17823-01 PDR			

COPIES SENT TO OFF. OF INSPECTION AND ENFORCEMENT

13849

13849

See info on next pg.

INFORMATION REQUIRED FOR ITEMS 7 THROUGH 23

For Items 7 through 23, check the appropriate box(es) and submit a detailed description of all the requested information. Begin each item on a separate sheet. Identify the item number and the date of the application in the lower right corner of each page. If you indicate that an appendix to the medical licensing guide will be followed, do not submit the pages, but specify the revision number and date of the referenced guide: Regulatory Guide 10.8 *Rev. _____ Date: _____

*NOTE: All appendices referenced on this page are based on Regulatory Guide 10.8, Revision 1, and are attached to the application. Some appendices have been slightly modified to reduce the regulatory burden.

7. MEDICAL ISOTOPES COMMITTEE (Page 5)		15. GENERAL RULES FOR THE SAFE USE OF RADIOACTIVE MATERIAL (Check One) (Page 18)	
X	Names and Specialties Attached; and (See Page 5)	X	Appendix G Rules Followed; or
X	Duties as in Appendix B; or _____ (Check One)		Equivalent Rules Attached
	Equivalent Duties Attached	16. EMERGENCY PROCEDURES (Check One) (Page 19)	
8. TRAINING AND EXPERIENCE (Page 7)		X	Appendix H Procedures Followed; or
X	Supplements A & B Attached for Each Individual User; and (See Page 7)		Equivalent Procedures Attached
	Supplement A Attached for RSO.	17. AREA SURVEY PROCEDURES (Check One) (Page 20)	
9. INSTRUMENTATION (Check One) (Page 8)		X	Appendix I Procedures Followed; or
X	Appendix C Form Attached; or		Equivalent Procedures Attached
	List by Name and Model Number	18. WASTE DISPOSAL (Check One) (Page 21)	
10. CALIBRATION OF INSTRUMENTS (Page 9)		X	Appendix J Form Attached; or
X	Appendix D Procedures Followed for Survey Instruments; or (See Page 9) _____ (Check One)		Equivalent Information Attached
	Equivalent Procedures Attached; and	19. THERAPEUTIC USE OF RADIOPHARMACEUTICALS (Check One) (Page 23)	
X	Appendix D Procedures Followed for Dose Calibrator; or _____ (Check One)	X	Appendix K Procedures Followed; or
	Equivalent Procedures Attached		Equivalent Procedures Attached
11. FACILITIES AND EQUIPMENT (Page 14)		20. THERAPEUTIC USE OF SEALED SOURCES	
X	Description and Diagram Attached	N/A	Detailed Information Attached; and
12. PERSONNEL TRAINING PROGRAM (Page 15)			Appendix L Procedures Followed; or _____ (Check One)
X	Description of Training Attached		Equivalent Procedures Attached
13. PROCEDURES FOR ORDERING AND RECEIVING RADIOACTIVE MATERIAL (Page 16)		21. PROCEDURES AND PRECAUTIONS FOR USE OF RADIOACTIVE GASES (e.g., Xenon - 133)	
X	Detailed Information Attached	N/A	Detailed Information Attached
14. PROCEDURES FOR SAFELY OPENING PACKAGES CONTAINING RADIOACTIVE MATERIALS (Check One) (Page 17)		22. PROCEDURES AND PRECAUTIONS FOR USE OF RADIOACTIVE MATERIAL IN ANIMALS	
		N/A	Detailed Information Attached
X	Appendix F Procedures Followed; or	23. PROCEDURES AND PRECAUTIONS FOR USE OF RADIOACTIVE MATERIAL SPECIFIED IN ITEM 6.b	
	Equivalent Procedures Attached	N/A	Detailed Information Attached

24. PERSONNEL MONITORING DEVICES

TYPE <small>(Check appropriate box)</small>		SUPPLIER	EXCHANGE FREQUENCY
a. WHOLE BODY	<input checked="" type="checkbox"/> FILM	R.S. Landauer, Jr. & Co. Landauer, Division of Tech/Ops, Inc.	
	<input type="checkbox"/> TLD	Glenwood Science Park, Glenwood, Ill. 60425	
	<input type="checkbox"/> OTHER (Specify)		
b. FINGER	<input type="checkbox"/> FILM		
	<input checked="" type="checkbox"/> TLD	See above	
	<input type="checkbox"/> OTHER (Specify)		
c. WRIST	<input type="checkbox"/> FILM		
	<input type="checkbox"/> TLD		
	<input type="checkbox"/> OTHER (Specify)		

d. OTHER (Specify) ALARA PROGRAM

This institution is committed to the ALARA program set forth in Appendix O, attached to this application beginning on page 27.

Applicant.....	14633
Check No.....	150-7B
Amount/Fee Category.....	Amendment
Type of Visa.....	2/18/83
Date Chg.....	Brown
Received by.....	

RECEIVED BY FMS	
Date.....	1/18/83
Log.....	Feb 3 Renewal
By.....	Brown
Orig.....	
Action.....	Brown

25. FOR PRIVATE PRACTICE APPLICANTS ONLY

a. HOSPITAL AGREEING TO ACCEPT PATIENTS CONTAINING RADIOACTIVE MATERIAL			b. ATTACH A COPY OF THE AGREEMENT LETTER SIGNED BY THE HOSPITAL ADMINISTRATOR.
NAME OF HOSPITAL			
MAILING ADDRESS			
CITY	STATE	ZIP CODE	c. WHEN REQUESTING THERAPY PROCEDURES, ATTACH A COPY OF RADIATION SAFETY PRECAUTIONS TO BE TAKEN AND LIST AVAILABLE RADIATION DETECTION INSTRUMENTS.

26. CERTIFICATE

(This item must be completed by applicant)

The applicant and any official executing this certificate on behalf of the applicant named in Item 1a certify that this application is prepared in conformity with Title 10, Code of Federal Regulations, Parts 30 and 35, and that all information contained herein, including any supplements attached hereto, is true and correct to the best of our knowledge and belief.

a. LICENSE FEE REQUIRED <i>(See Section 170.31, 10 CFR 170)</i>		b. APPLICANT OR CERTIFYING OFFICIAL (Signature) <div style="text-align: center;"> RICHARD C. ATKINS (1) NAME (Type of Print) ADMINISTRATOR (2) TITLE </div>
(1) LICENSE FEE CATEGORY: 7B		c. DATE FEBRUARY 10, 1983
(2) LICENSE FEE ENCLOSED: \$ 150.00		12879

PRIVACY ACT STATEMENT

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

1. **AUTHORITY** Sections 81 and 161(b) of the Atomic Energy Act of 1954, as amended (42 U.S.C. 2111 and 2201(b)).
2. **PRINCIPAL PURPOSE(S)** The information is evaluated by the NRC staff pursuant to the criteria set forth in 10 CFR Parts 30-36 to determine whether the application meets the requirements of the Atomic Energy Act of 1954, as amended, and the Commission's regulations, for the issuance of a radioactive material license or amendment thereof.
3. **ROUTINE USES** The information may be used: (a) to provide records to State health departments for their information and use, and (b) to provide information to Federal, State, and local health officials and other persons in the event of incident or exposure, for their information, investigation, and protection of the public health and safety. The information may also be disclosed to appropriate Federal, State, and local agencies in the event that the information indicates a violation or potential violation of law and in the course of an administrative or judicial proceeding. In addition, this information may be transferred to an appropriate Federal, State, or local agency to the extent relevant and necessary for a NRC decision or to an appropriate Federal agency to the extent relevant and necessary for that agency's decision about you. A copy of the license issued will routinely be placed in the NRC's Public Document Room, 1717 H Street, N.W., Washington, D.C.
4. **WHETHER DISCLOSURE IS MANDATORY OR VOLUNTARY AND EFFECT ON INDIVIDUAL OF NOT PROVIDING INFORMATION** Disclosure of the requested information is voluntary. If the requested information is not furnished, however, the application for radioactive material license, or amendment thereof, will not be processed.
5. **SYSTEM MANAGER(S) AND ADDRESS** Director, Division of Fuel Cycle and Material Safety, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

RADIATION SAFETY/Medical Isotopes Committee

The membership of this committee will consist of at least three members and will include:

1. the radiation safety officer;
2. the hospital administrator, or other administrative official directly responsible to the hospital administrator in the hospital's internal chain of command;
3. a physician* specialist from each department where radioactive materials are used; and
4. a representative of the hospital's nursing staff.

The names and qualifications of the committee members will be documented in the committee's records, will be updated as necessary, and will be available for inspection by the NRC.

*Some departments, such as the nuclear pharmacy, may not be under the supervision of a physician. In these cases, the supervisory paramedical professional will be a member of the committee.

APPENDIX B

MEDICAL ISOTOPES COMMITTEE*

Responsibility

The committee is responsible for :

1. Ensuring that all individuals who work with or in the vicinity of radioactive material have sufficient training and experience to enable them to perform their duties safely and in accordance with NRC regulations and the conditions of the license.
2. Ensuring that all use of radioactive material is conducted in a safe manner and in accordance with NRC regulations and the conditions of the license.

Duties

The committee shall:

1. Be familiar with all pertinent NRC regulations, the terms of the license, and information submitted in support of the request for the license and its amendments.
2. Review the training and experience of all individuals who use radioactive material (including physicians, technologists, physicists, and pharmacists) and determine that their qualifications are sufficient to enable them to perform their duties safely and in accordance with NRC regulations and the conditions of the license.
3. Establish a program to ensure that all individuals whose duties may require them to work in the vicinity of radioactive material (e.g., nursing, security, and house-

keeping personnel) are properly instructed as required by §19.12 of 10 CFR Part 19.

4. Review and approve all requests for use of radioactive material within the institution.
5. Prescribe special conditions that will be required during a proposed use of radioactive material such as requirements for bioassays, physical examinations of users, and special monitoring procedures.
6. Review the entire radiation safety program at least annually to determine that all activities are being conducted safely and in accordance with NRC regulations and the conditions of the license. The review shall include an examination of all records, reports from the radiation safety officer, results of NRC inspection, written safety procedures, and the adequacy of the institution's management control system.
7. Recommend remedial action to correct any deficiencies identified in the radiation safety program.
8. Maintain written records of all committee meetings, actions, recommendations, and decisions.
9. Ensure that the byproduct material license is amended, when necessary, prior to any changes in facilities, equipment, policies, procedures, and personnel, as specified in the license.

Meeting Frequency

The medical isotopes committee shall meet as often as necessary to conduct its business but not less than once in each calendar quarter.

* A rule is expected in 1981 that would change the name, composition, and functions of this committee.

NAME OF AUTHORIZED USER*

Paul Wm. Anderson, M.D.

AUTHORIZATION

Groups I, II, III and IV

*If you wish to add additional names to the list, follow the instructions in Item 8 on page 4 of Regulatory Guide 10.8.

APPENDIX C
INSTRUMENTATION

1. Survey meters

- a. Manufacturer's name: EDN
Manufacturer's model number: PSM 790
Number of instruments available: 1
Minimum range: 0 mR/hr to 10 mR/hr
Maximum range: 0 mR/hr to 1000 mR/hr
- b. Manufacturer's name: Victoreen
Manufacturer's model number: 701
Number of instruments available: 1
Minimum range: 0 mR/hr to .5 mR/hr
Maximum range: 0 mR/hr to 50 mR/hr

2. Dose calibrator

Manufacturer's name: Capintec
Manufacturer's model number: CRC-6
Number of instruments available: 1

3. Instruments used for diagnostic procedures

Type of Instrument	Manufacturer's Name	Model No.
Gamma Camera	Technicare	438HR-II

4. Other (e.g., liquid scintillation counter, area monitor, velometer)

CALIBRATION OF SURVEY INSTRUMENTS

Check appropriate items.

- X 1. Survey instruments will be calibrated at least annually and following repair.
- X 2. Calibration will be performed at two points on each scale used for radiation protection purposes, i.e., at least up to 1 R/hr.

The two points will be approximately 1/3 and 2/3 of full scale. A survey instrument may be considered properly calibrated when the instrument readings are within ± 10 percent of the calculated or known values for each point checked. Readings within ± 20 percent are considered acceptable if a calibration chart, graph, or response factor is prepared, attached to the instrument, and used to interpret readings to within ± 10 percent. Also, when higher scales are not checked or calibrated, an appropriate precautionary note will be posted on the instrument.

3. Survey instruments will be calibrated

- a. By the manufacturer

- b. At the licensee's facility

- | (1) | Calibration source
Radionuclide |
|-----|------------------------------------|
| 1 | ⁶⁰ Co |
| 2 | ¹³⁷ Cs |
| 3 | ¹⁵² Eu |
| 4 | ¹⁵⁴ Eu |
| 5 | ¹⁵⁹ Gd |
| 6 | ¹⁶⁹ Yb |
| 7 | ¹⁷⁰ Yb |
| 8 | ¹⁷⁶ Lu |
| 9 | ¹⁸⁸ Re |
| 10 | ¹⁹² Ir |
| 11 | ¹⁹⁴ Ir |
| 12 | ¹⁹⁸ Au |
| 13 | ²⁰³ Pb |
| 14 | ²⁰³ Tl |
| 15 | ²⁰⁴ Pb |
| 16 | ²⁰⁴ Tl |
| 17 | ²⁰⁸ Tl |
| 18 | ²¹⁰ Pb |
| 19 | ²¹⁰ Bi |
| 20 | ²¹⁰ Po |
| 21 | ²¹⁰ Pb |
| 22 | ²¹⁰ Bi |
| 23 | ²¹⁰ Po |
| 24 | ²¹⁰ Pb |
| 25 | ²¹⁰ Bi |
| 26 | ²¹⁰ Po |
| 27 | ²¹⁰ Pb |
| 28 | ²¹⁰ Bi |
| 29 | ²¹⁰ Po |
| 30 | ²¹⁰ Pb |
| 31 | ²¹⁰ Bi |
| 32 | ²¹⁰ Po |
| 33 | ²¹⁰ Pb |
| 34 | ²¹⁰ Bi |
| 35 | ²¹⁰ Po |
| 36 | ²¹⁰ Pb |
| 37 | ²¹⁰ Bi |
| 38 | ²¹⁰ Po |
| 39 | ²¹⁰ Pb |
| 40 | ²¹⁰ Bi |
| 41 | ²¹⁰ Po |
| 42 | ²¹⁰ Pb |
| 43 | ²¹⁰ Bi |
| 44 | ²¹⁰ Po |
| 45 | ²¹⁰ Pb |
| 46 | ²¹⁰ Bi |
| 47 | ²¹⁰ Po |
| 48 | ²¹⁰ Pb |
| 49 | ²¹⁰ Bi |
| 50 | ²¹⁰ Po |
| 51 | ²¹⁰ Pb |
| 52 | ²¹⁰ Bi |
| 53 | ²¹⁰ Po |
| 54 | ²¹⁰ Pb |
| 55 | ²¹⁰ Bi |
| 56 | ²¹⁰ Po |
| 57 | ²¹⁰ Pb |
| 58 | ²¹⁰ Bi |
| 59 | ²¹⁰ Po |
| 60 | ²¹⁰ Pb |
| 61 | ²¹⁰ Bi |
| 62 | ²¹⁰ Po |
| 63 | ²¹⁰ Pb |
| 64 | ²¹⁰ Bi |
| 65 | ²¹⁰ Po |
| 66 | ²¹⁰ Pb |
| 67 | ²¹⁰ Bi |
| 68 | ²¹⁰ Po |
| 69 | ²¹⁰ Pb |
| 70 | ²¹⁰ Bi |
| 71 | ²¹⁰ Po |
| 72 | ²¹⁰ Pb |
| 73 | ²¹⁰ Bi |
| 74 | ²¹⁰ Po |
| 75 | ²¹⁰ Pb |
| 76 | ²¹⁰ Bi |
| 77 | ²¹⁰ Po |
| 78 | ²¹⁰ Pb |
| 79 | ²¹⁰ Bi |
| 80 | ²¹⁰ Po |
| 81 | ²¹⁰ Pb |
| 82 | ²¹⁰ Bi |
| 83 | ²¹⁰ Po |
| 84 | ²¹⁰ Pb |
| 85 | ²¹⁰ Bi |
| 86 | ²¹⁰ Po |
| 87 | ²¹⁰ Pb |
| 88 | ²¹⁰ Bi |
| 89 | ²¹⁰ Po |
| 90 | ²¹⁰ Pb |
| 91 | ²¹⁰ Bi |
| 92 | ²¹⁰ Po |
| 93 | ²¹⁰ Pb |
| 94 | ²¹⁰ Bi |
| 95 | ²¹⁰ Po |
| 96 | ²¹⁰ Pb |
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| 113 | ²¹⁰ Po |
| 114 | ²¹⁰ Pb |
| 115 | ²¹⁰ Bi |
| 116 | ²¹⁰ Po |
| 117 | ²¹⁰ Pb |
| 118 | ²¹⁰ Bi |
| 119 | ²¹⁰ Po |
| 120 | ²¹⁰ Pb |
| 121 | ²¹⁰ Bi |
| 122 | ²¹⁰ Po |
| 123 | ²¹⁰ Pb |
| 124 | ²¹⁰ Bi |
| 125 | ²¹⁰ Po |
| 126 | ²¹⁰ Pb |
| 127 | ²¹⁰ Bi |
| 128 | ²¹⁰ Po |
| 129 | ²¹⁰ Pb |
| 130 | ²¹⁰ Bi |
| 131 | ²¹⁰ Po |
| 132 | ²¹⁰ Pb |
| 133 | ²¹⁰ Bi |
| 134 | ²¹⁰ Po |
| | |

Manufacturer's name

Model no.

Activity in millicuries

or

Exposure rate at a specified distance

Accuracy

Traceability to primary standard

- (2) The calibration procedures in Section I of Appendix D will be used

or

- (3) The step-by-step procedures, including radiation safety procedures, are attached.

- c. By a consultant or outside firm

- (1) Name Rod Wimmer, Ph.D.

- (2) Location Columbus Hospital, 500 15th Ave. South, Great Falls, Mt.

- ### (3) Procedures and sources

X have been approved by NRC and are on file in License No. 25-02337-03

_____ have been approved by an Agreement State: a copy of the Agreement State license, the procedures, and a description of the sources are attached, and the consultant's report will contain the information on _____

_____ the attached "Certificate of Instrument Calibration."

the consultant's re ng form as attached.

_____ are described in the _____ and the consultant's report will contain the information on _____

_____ the attached "Certificate of Instrument Calibration."

the consultant's reporting form as attached.

CALIBRATION OF DOSE CALIBRATOR

A. Sources Used for Linearity Test

(Check as appropriate)

X First elution from new Mo-99/Tc-99m generator

X Other* (specify) ^{or} If generators are not in use, a source of Tc-99m with activity equivalent to the maximum activity assayed to clinical situations will be used.

B. Sources Used for Instrument Accuracy and Constancy Tests

Radionuclide	Suggested Activity (mCi)	Activity (mCi)	Accuracy
Co-57	3-5	One millicurie or more	within \pm 5%
Ba-133	0.1-0.5	100 microcuries or more	within \pm 5%
Cs-137	0.1-0.2	100 microcuries or more	within \pm 5%
Ra-226	1-2	<u>N/A</u>	<u>N/A</u>
<u>N/A</u>		<u>N/A</u>	<u>N/A</u>

C. X The procedures described in Section 2 of Appendix D will be used for calibration of the dose calibrator

or

 Equivalent procedures are attached.

*For licensees who are not authorized for Mo-99/Tc-99m generators, activity must be equivalent to the highest activity used.

APPENDIX D (Continued)

Section 2

METHODS FOR CALIBRATION OF DOSE CALIBRATOR*

All radiopharmaceuticals must be assayed for activity to an accuracy of 10 percent. The most common instrument for accomplishing this is an ionization-type dose calibrator. The instrument must be checked for accurate operation at the time of installation and periodically thereafter.

A. Test for the following:

1. Instrument constancy (daily)
2. Instrument accuracy (at installation and annually thereafter)
3. Instrument linearity (at installation and quarterly thereafter)
4. Geometrical variation (at installation)

B. After repair or adjustment of the dose calibrator, repeat all the appropriate tests listed above (dependent upon the nature of the repairs).

C. Test for Instrument Constancy

Instrument constancy means that there is reproducibility, within a stated acceptable degree of precision, in measuring a constant activity over time. Assay at least one relatively long-lived reference source such as Cs-137, Co-57,** or Ra-226** using a reproducible geometry before each day's use of the instrument. Preferably, at least two reference sources (for example, 3-5 mCi of Co-57 and 100-200 μ Ci of Cs-137 or 1-2 mg Ra-226 (with appropriate decay corrections) will be alternated each day of use to test the instrument's performance over a range of photon energies and source activities.

1. Assay each reference source using the appropriate instrument setting (i.e., Cs-137 setting for Cs-137).
2. Measure background level at same instrument setting, or check that automatic background subtraction is operating properly when blanks are inserted in the calibrator.

* See ANSI N42.13-1978, "Calibration and Usage of Dose Calibrator Ionization Chambers for the Assay of Radionuclides" (American National Standards Institute, Inc., 1430 Broadway, New York, N.Y. 10018).

** Co-57 and Ra-226 are not subject to NRC licensing; the respective State agency should be consulted to determine its requirements for possessing this material.

3. Calculate net activity of each source subtracting out background level.
4. For each source, plot net activity versus the day of the year on semilog graph paper.
5. Log the background levels.
6. Indicate the predicted activity of each source based on decay calculations and the ± 5 percent limits on the graph.
7. Repeat the procedure used for the Cs-137 source for all the commonly used radionuclide settings.
8. Variations greater than ± 5 percent from the predicted activity indicate the need for instrument repair or adjustment.
9. Investigate higher than normal background levels to determine their origin and to eliminate them if possible by decontamination, relocation, etc.

D. Inspect the instrument on a quarterly basis to ascertain that the measurement chamber liner is in place and that instrument zero is properly set (see manufacturer's instructions).

E. Test of Instrument Linearity

The linearity of a dose calibrator should be ascertained over the entire range of activities employed. This test will use a vial of Tc-99m whose activity is equivalent to the maximum anticipated activity to be assayed (e.g., the first elution from a new generator).

1. Assay the Tc-99m vial in the dose calibrator, and subtract background level to obtain net activity in millicuries.
2. Repeat step 1 at time intervals of 6, 24, 30, and 48 hours after the initial assay.
3. Using the 30-hour activity measurement as a starting point, calculate the predicted activities at 0, 6, 24, and 48 hours using the following table:

Assay Time* (hr)	Correction Factor
0	31.633
6	15.853
24	1.995
30	1
48	0.126

Example: If the net activity measured at 30 hours was 15.625 mCi, the calculated activities for 6 and 48 hours would be $15.625 \text{ mCi} \times 15.853 = 247.7 \text{ mCi}$ and $15.625 \text{ mCi} \times 0.126 = 1.97 \text{ mCi}$, respectively.

- On semi-log coordinate paper, plot the measured net activity and the calculated activity versus time.
- The activities plotted should be within ± 5 percent of the calculated activity if the instrument is linear and functioning properly. Errors greater than ± 5 percent indicate the need for repair or adjustment of the instrument.
- If instrument linearity cannot be corrected, it will be necessary in routine assays to use either (a) an aliquot of the eluate that can be accurately measured or (b) the graph constructed in step 4 to relate measured activities to calculated activities.

F. Test for Geometrical Variation

There may be significant geometrical variation in activity measured as a function of sample volume or configuration, depending on the volume and size of the ionization chamber used in the dose calibrator. The extent of geometrical variation should be ascertained for commonly used radionuclides and appropriate correction factors computed if variations are significant, i.e., greater than ± 2 percent. (Even though correction factors may be provided by the manufacturer, the accuracy of these should be checked.) When available from the manufacturer, certified data on geometrical variations may be used in lieu of these measurements.

To measure variation with volume of liquid, a 30-cc vial containing 2 mCi of Co-57 or other appropriate radionuclide in a volume of 1 ml will be used.

- Assay vial at the appropriate instrument setting, and subtract background level to obtain net activity.
- Increase the volume of liquid in the vial in steps to 2, 4, 8, 10, 20, and 25 ml by adding the appropriate amount of water or saline. After each addition, gently shake vial to mix contents and assay

* Assay times should be measured in whole hours and correction factors should be used to the third decimal place as indicated. The more recent half-life of $T_{1/2} = 6.02$ hours has been used in calculating these correction factors.

as in step 1. (Follow good radiation safety practices to avoid contamination and to minimize radiation exposure.)

- Select one volume as a standard (such as the volume of reference standard used in performing the test for instrument accuracy), and calculate the ratio of measured activities for each volume to the reference volume activity. This represents the volume correction factor (CF).

Example: If activities of 2.04, 2.02, and 2.00 mCi are measured for 4, 8, and 10 ml volumes and 10 ml is the reference volume selected.

$$4 \text{ ml Volume CF} = \frac{2.00}{2.04} = 0.98$$

- Plot the correction factors against the volume on linear graph paper. Use this graph to select the proper volume correction factors for routine assay of that radionuclide.
- The true activity of a sample is calculated as follows:

$$\text{True Activity} = \text{Measured Activity} \times \text{Correction Factor}$$

where the correction factor used is for the same volume and geometrical configuration as the sample measured.

- Similarly, the same activity of Co-57 in a syringe may be compared with that of 10 ml in a 30-cc vial, and a correction factor may be calculated.
- It should be noted that differences of 200 percent in dose calibrator readings between glass and plastic syringes have been observed for lower-energy radionuclides such as I-125, which should be assayed in a dose calibrator only if the reliability of such an assay can be established. Glass tubes and syringes may also vary enough in thickness to cause significant errors in assaying I-125. Hence, adequate correction factors must be established.

An alternative to providing syringe calibration factors is to simply assay the stock vial before and after filling the syringe. The activity in the syringe is then the difference in the two readings (with a volume correction if significant).

G. Test for Instrument Accuracy

Check the accuracy of the dose calibrator for several radionuclides, including Cs-137, Co-57, and Ba-133, using appropriate reference standards whose activities have been calibrated by comparisons with standard sources that have been assayed by NBS and documented.

The activity levels of the reference sources used should approximate those levels normally encountered in clinical use (e.g., Co-57, 3-5 millicuries) giving adequate attention to source configuration. Identify in your application the three sources that you will use. State nuclide, activity, and calibration accuracy. The lower-energy reference standards (Tc-99m, Xe-133, I-125) must be in vials with the same thickness of glass as the actual samples to be measured for best accuracy.

1. Assay the reference standard in the dose calibrator at the appropriate setting, and subtract the background level to obtain the net activity.
2. Repeat step 1 for a total of 3 determinations, and average results.
3. The average activity determined in step 2 should agree with the certified activity of the reference source within ± 5 percent after decay corrections.

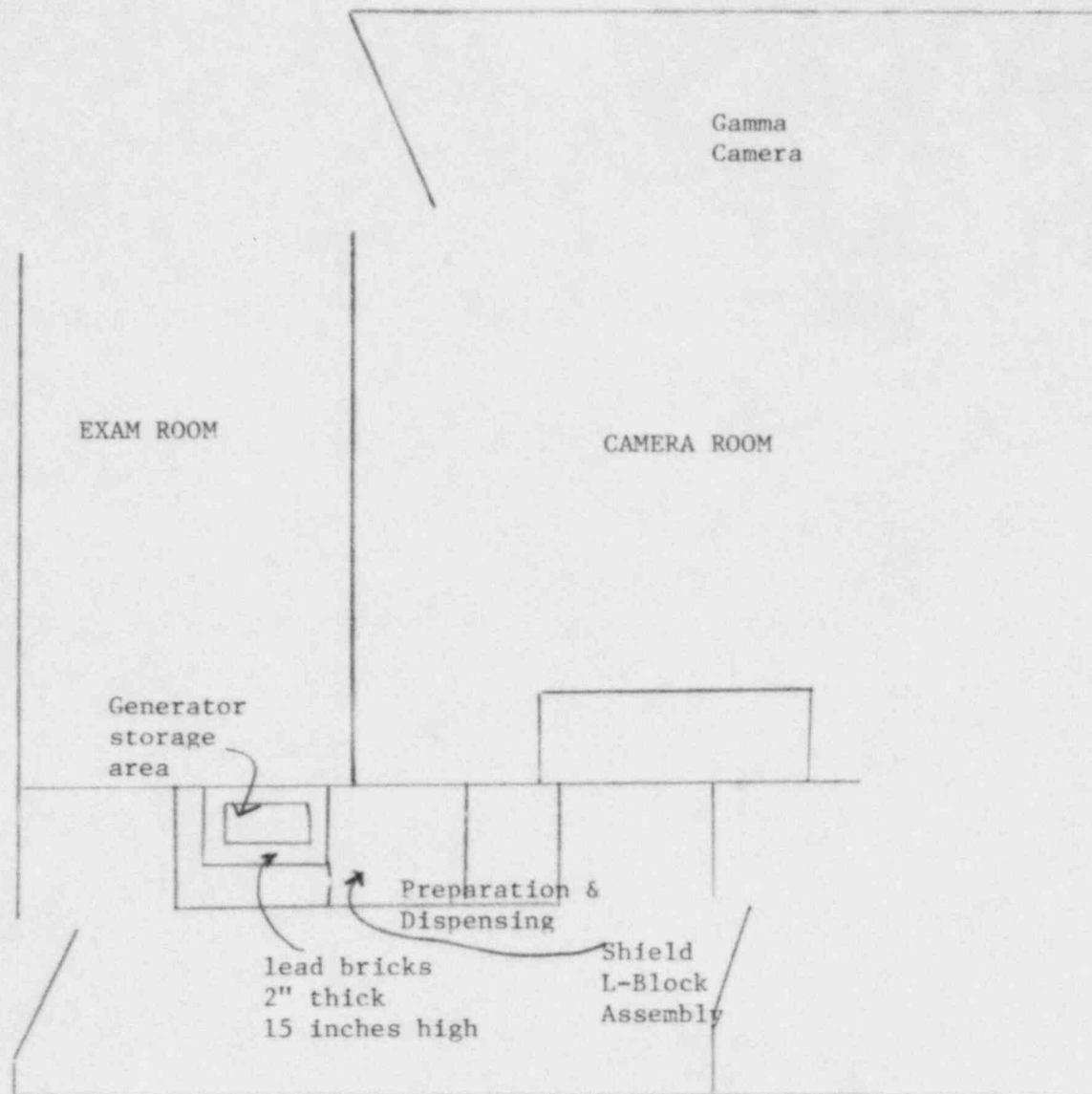
4. Repeat the above steps for other commonly used radionuclides for which adequate reference standards are available.
5. Keep a log of these calibration checks.
6. Calibration checks that do not agree within ± 5 percent indicate that the instrument should be repaired or adjusted. If this is not possible, a calibration factor should be calculated for use during routine assays of radionuclides.
7. At the same time the instrument is being initially calibrated at the licensee's facility with the reference standards, place a long-lived source in the calibrator, set the instrument, in turn, at the various radionuclide settings used (Cs-137, I-131, Tc-99m, I-125, etc.), and record the readings. These values may later be used to check instrument calibration at each setting (after correcting for decay of the long-lived source) without requiring more reference standards. Keep a log of these initial and subsequent readings.

FACILITY DIAGRAM
(Prepare and Attach to Application)

Submit a detailed diagram of the facility, indicating the type, dimensions, position, and thickness of shielding that will be used for:

- a. Use and storage of Tc-99m generators.
- b. Storage of radiopharmaceuticals (refrigerated and nonrefrigerated).
- c. Storage of radioactive waste, including decay-in-storage prior to disposal as nonradioactive waste. (This area should be large enough to handle an accumulation of used Tc-99m generators as well as other solid waste. If this area is located outside your department, describe how the material will be secured. Confirm that this area will be surveyed at least weekly.)
- d. Preparation and dispensing of Group III kit radiopharmaceuticals (e.g., lead glass L-block).

Identify adjacent areas across the walls from use and storage locations, and show that adequate steps have been taken to ensure that radiation levels in unrestricted areas do not exceed the limits specified in paragraph 20.105(b) of 10 CFR Part 20.



Long term
decay area
is located on
second floor
in seldom
occupied air
conditioning
maintenance area

Figure 1

PERSONNEL TRAINING PROGRAM

- I. Individuals who work in or frequent restricted areas will be instructed in the items specified in 10 CFR 19.12 at the time of initial employment and at least annually thereafter.

This instruction will include:

- a. All terms of the license pertinent to radiation safety.
- b. Areas where radioactive material is used or stored.
- c. Potential hazards associated with radioactive material.
- d. Radiological safety procedures appropriate to their respective duties.
- e. Pertinent NRC regulations.
- f. Rules and regulations of the license.
- g. Obligation to report unsafe conditions to the radiation safety officer.
- h. Appropriate response to emergencies or unsafe conditions.
- i. Right to be informed of their radiation exposure and bioassay results.
- j. Locations where the licensee has posted or made available notices, copies of pertinent regulations, and copies of pertinent licenses and license conditions (including applications and applicable correspondence), as required by 10 CFR Part 19.

- II. Individuals whose duties may require them to work in the vicinity of licensed material will be informed about radiation hazards and appropriate precautions at the time of initial employment and at least annually thereafter. This information will be provided initially at hospital employee orientation sessions and annually thereafter at in-service meetings.

APPENDIX E

PROCEDURES FOR ORDERING AND ACCEPTING DELIVERY OF RADIOACTIVE MATERIAL

1. The Supervisory Nuclear Medicine Technologist will place all orders for radioactive materials and will ensure that the requested materials and quantities are authorized by the license and that possession limits are not exceeded.
 2. A system for ordering and receiving radioactive materials will be established and maintained. The system will consist minimally of the following:
 - a. Ordering of routinely used materials
 - (1) Written records that identify the isotope, compound, activity levels, and supplier, etc., will be used.
 - (2) The written records will be referenced when opening or storing radioactive shipment.
 - b. Ordering of specially used materials (e.g., therapeutic uses)
 - (1) A written request* will be obtained from the physician who will perform the procedure.
 - (2) Persons ordering the materials will reference the physician's written request when placing the order. The physician's request will indicate isotope, compound, activity level, etc.
 - (3) The physician's written request will be referenced when receiving, opening, or storing the radioactive material.
 - c. It is essential that written records* be maintained for all ordering and receipt procedures.
 3. During normal working hours, carriers will be instructed to deliver radioactive packages directly to the Nuclear Medicine Department.
 4. During off-duty hours, security personnel or other designated individuals will accept delivery of radioactive packages in accordance with the procedures outlined in the sample memorandum below.
- * In the case of special orders, the physician's written request and appropriate shipping/receipt records will be referenced and the dose assayed prior to its administration.

SAMPLE** MEMORANDUM

MEMORANDUM FOR: Security Personnel
FROM: Hospital Administrator
SUBJECT: RECEIPT OF PACKAGES CONTAINING RADIOACTIVE MATERIAL

Any packages containing radioactive material that arrive between 4:30 p.m. and 7 a.m. or on Sundays shall be signed for by the Security Guard on duty and taken immediately to the Nuclear Medicine Department. Unlock the door, place the package on top of the counter immediately to the right of the door, and relock the door.

If the package is wet or appears to be damaged immediately contact the Radiation Safety Officer. Ask the carrier to remain until it can be determined that neither he nor the delivery vehicle is contaminated.

**RADIATION SAFETY OFFICER _____
**OFFICE PHONE _____
**HOME PHONE _____

**On the actual memo that is used, this information will be filled in and updated as necessary.