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

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

Radiologists, Inc.
6724 Troost Suite #900
Kansas City, MO 64131

TELEPHONE NO.: AREA CODE (816) 333 - 8420

1.b. STREET ADDRESS(ES) AT WHICH RADIOACTIVE MATERIAL WILL BE USED *(If different from 1.a.)* INCLUDE ZIP CODE

Same

2. PERSON TO CONTACT REGARDING THIS APPLICATION

Roger W. Lambie, M.D.
TELEPHONE NO.: AREA CODE ( ) _____

3. THIS IS AN APPLICATION FOR: *(Check appropriate item)*

a. ☐ NEW LICENSE
b. ☐ AMENDMENT TO LICENSE NO. _____
c. ☒ RENEWAL OF LICENSE NO. 24-20047-01

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.)*

Roger W. Lambie, M.D.

6.a. RADIOACTIVE MATERIAL FOR MEDICAL USE

RADIOACTIVE MATERIAL LISTED IN:	ITEMS DESIRED "X"	MAXIMUM POSSESSION LIMITS (In millicuries)
10 CFR 31.11 FOR IN VITRO STUDIES	N/A	
10 CFR 35.100, SCHEDULE A, GROUP I	X	AS NEEDED
10 CFR 35.100, SCHEDULE A, GROUP II	X	AS NEEDED
10 CFR 35.100, SCHEDULE A, GROUP III	N/A	
10 CFR 35.100, SCHEDULE A, GROUP IV	X	AS NEEDED
10 CFR 35.100, SCHEDULE A, GROUP V	N/A	AS NEEDED
10 CFR 35.100, SCHEDULE A, GROUP VI	N/A	

ADDITIONAL ITEMS:	MARK ITEMS DESIRED "X"	MAXIMUM POSSESSION LIMITS (In millicuries)
IODINE-131 AS IODIDE FOR TREATMENT OF HYPERTHYROIDISM	N/A	
PHOSPHORUS-32 AS SOLUBLE PHOSPHATE FOR TREATMENT OF POLYCYTHEMIA VERA, LEUKEMIA AND BONE METASTASES	N/A	
PHOSPHORUS-32 AS COLLOIDAL CHROMIC PHOSPHATE FOR INTRACAVITARY TREATMENT OF MALIGNANT EFFUSIONS.	N/A	
GOLD-198 AS COLLOID FOR INTRACAVITARY TREATMENT OF MALIGNANT EFFUSIONS.	N/A	
IODINE-131 AS IODIDE FOR TREATMENT OF THYROID CARCINOMA	N/A	
XENON-133 AS GAS OR GAS IN SALINE FOR BLOOD FLOW STUDIES AND PULMONARY FUNCTION STUDIES	X	200

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
153-Gadolinium	Sealed Source	1500	Bone mineral analysis See Page 33.

Applicant Dec 3 AM II
Check No. 9323
Amount, Fee Category $550 (4C)
Type of Fee REN
Date Check Rec'd 12/3/85
Received By AMC

NRC FORM 313M (9-81)

8604040633 860124
REG3 LIC30
24-20047-01 PDR

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)

X	~~Names and Specialties Attached; and~~ (See page 5)
X	Duties as in Appendix B; or (Check One)
	Equivalent Duties Attached

8. TRAINING AND EXPERIENCE (Page 7)

X	~~Supplements A & B Attached for Each Individual User; and~~ (See page 7)
	Supplement A Attached for RSO.

9. INSTRUMENTATION (Check One) (Page 8)

X	Appendix C Form Attached; or
	List by Name and Model Number

10. CALIBRATION OF INSTRUMENTS (Page 9)

	~~Appendix D Procedures Followed for Survey Instruments; or~~ (See page 9) (Check One)
	Equivalent Procedures Attached; and
X	Appendix D Procedures Followed for Dose Calibrator; or (Check One)
	Equivalent Procedures Attached

11. FACILITIES AND EQUIPMENT (Page 14)

X	Description and Diagram Attached

12. PERSONNEL TRAINING PROGRAM (Page 15)

X	Description of Training Attached

13. PROCEDURES FOR ORDERING AND RECEIVING RADIOACTIVE MATERIAL (Page 16)

X	Detailed Information Attached

14. PROCEDURES FOR SAFELY OPENING PACKAGES CONTAINING RADIOACTIVE MATERIALS (Check One) (Page 17)

X	Appendix F Procedures Followed; or
	Equivalent Procedures Attached

15. GENERAL RULES FOR THE SAFE USE OF RADIOACTIVE MATERIAL (Check One) (Page 18)

X	Appendix G Rules Followed; or
	Equivalent Rules Attached

16. EMERGENCY PROCEDURES (Check One) (Page 19)

X	Appendix H Procedures Followed; or
	Equivalent Procedures Attached

17. AREA SURVEY PROCEDURES (Check One) (Page 20)

X	Appendix I Procedures Followed; or
	Equivalent Procedures Attached

18. WASTE DISPOSAL (Check One) (Page 21)

X	Appendix J Form Attached; or
	Equivalent Information Attached

19. THERAPEUTIC USE OF RADIOPHARMACEUTICALS (Check One)

X	Appendix K Procedures Followed; or
	Equivalent Procedures Attached

20. THERAPEUTIC USE OF SEALED SOURCES

N/A	Detailed Information Attached; and
	Appendix L Procedures Followed; or (Check One)
	Equivalent Procedures Attached

21. PROCEDURES AND PRECAUTIONS FOR USE OF RADIOACTIVE GASES (e.g., Xenon – 133) (Page 22)

X	Detailed Information Attached

22. PROCEDURES AND PRECAUTIONS FOR USE OF RADIOACTIVE MATERIAL IN ANIMALS

N/A	Detailed Information Attached

23. PROCEDURES AND PRECAUTIONS FOR USE OF RADIOACTIVE MATERIAL SPECIFIED IN ITEM 6.b

::	Detailed Information Attached (Page 33)

24. PERSONNEL MONITORING DEVICES

TYPE (Check appropriate box)			SUPPLIER	EXCHANGE FREQUENCY
a. WHOLE BODY	X	FILM	R.S. Landauer, Jr & Company	monthly
		TLD		
		OTHER (Specify)		
b. FINGER		FILM		
	X	TLD	R.S. Landauer, Jr & Company	monthly
		OTHER (Specify)		
c. WRIST		FILM		
		TLD		
		OTHER (Specify)		

d. OTHER (Specify)

This institution is committed to the ALARA Program as set forth in Appendix O attached to this application beginning on Page 29.

25. FOR PRIVATE PRACTICE APPLICANTS ONLY

a. HOSPITAL AGREEING TO ACCEPT PATIENTS CONTAINING RADIOACTIVE MATERIAL

NAME OF HOSPITAL

MAILING ADDRESS

CITY | STATE | ZIP CODE

b. ATTACH A COPY OF THE AGREEMENT LETTER SIGNED BY THE HOSPITAL ADMINISTRATOR.

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
(See Section 170.31, 10 CFR 170)

(1) LICENSE FEE CATEGORY: 7C

(2) LICENSE FEE ENCLOSED: $ 580.00

b. APPLICANT OR CERTIFYING OFFICIAL (Signature)
Rodger W. Lambie MD

(1) NAME (Type or Print)
Rodger W. Lambie, M.D.

(2) TITLE
President, Radiologists, Inc.

c. DATE
November 15, 1985

NRC FORM 313M (9-81)

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.

*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.

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.

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 housekeeping 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.

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

NAME OF AUTHORIZED USER*	PREVIOUS AUTHORIZATION	AUTHORIZATION
Roger W. Lambie	24-20047-01 24-01239-01	Groups I,II,~~IV~~ I-131 133-Xenon, 153-Gadolinium
Edwin M. Herman	24-20047-01 24-01239-01	Groups I,II,~~IV~~ I-131 133-Xenon, 153-Gadolinium
Mordecai Kopperman	24-20047-01 24-01239-01	Groups I,II,~~IV~~ I-131 133-Xenon, 153-Gadolinium
Curtis S. Hammerman	Training and experience enclosed.	Groups I,II,~~IV~~ I-131 133-Xenon, 153-Gadolinium

I, II
I-131 for treatment of hyperthyroidism and cardiac dysfunction
Gadolinium-153

*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: Victoreen

Manufacturer's model number: 498

Number of instruments available: One (1)

Minimum range: 0 mR/hr to 1 mR/hr

Maximum range: 0 mR/hr to 1000 mR/hr

b. Manufacturer's name: _____

Manufacturer's model number: _____

Number of instruments available: _____

Minimum range: _____ mR/hr to _____ mR/hr

Maximum range: _____ mR/hr to _____ mR/hr

2. Dose calibrator

Manufacturer's name: Capintec

Manufacturer's model number: CRC-5

Number of instruments available: One (1)

3. Instruments used for diagnostic procedures

Type of Instrument	Manufacturer's Name	Model No.
Maxicamera Modular Scintilation Camera	General Electric	400T-37
Pulmonex Xenon System	Atomic Products	130-500

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

__X__ a. By the manufacturer

_____ b. At the licensee's facility

(1) Calibration source
Radionuclide _____
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.

__X__ c. By a consultant or outside firm

(1) Name Syncor International Corporation

(2) Location 1734 East 63rd Street #214, Kansas City, MO 64110

(3) Procedures and sources

__X__ have been approved by NRC and are on file in License No 24-16617-01MD

_____ 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 reporting form as attached.

_____ are described in the attachment, 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) 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 ± 5%
Ba-133	0.1-0.5	100 microcuries or more	within ± 5%
Cs-137	0.1-0.2	100 microcuries or more	within ± 5%
Ra-226	1-2	N/A	N/A
N/A		N/A	N/A

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.

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 μCi 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.

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 dec. y 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.

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* 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.

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 mCi x 15.853 = 247.7 mCi and 15.625 mCi x 0.126 = 1.97 mCi, respectively.

4. On log log coordinate paper, plot the measured net activity (for each time interval) versus the calculated activity (for the same time interval).

5. 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.

6. 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.

1. Assay vial at the appropriate instrument setting, and subtract background level to obtain net activity.

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

3. 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,

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

4. 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.

5. 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.

6. 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.

7. 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

* 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.

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.

* Actual % Variation will be calculated and recorded rather than plotting a graph.

** As an option, we request authorization to perform instrument linearity with the Calicheck ™, supplied by Calcorp, Inc. Cleveland, Ohio.

FACILITIES & EQUIPMENT

The following items are provided for handling radioactive material and will be used appropriately:

a. disposable gloves

b. syringe shields

c. lead vial shields

d. tongs and forceps

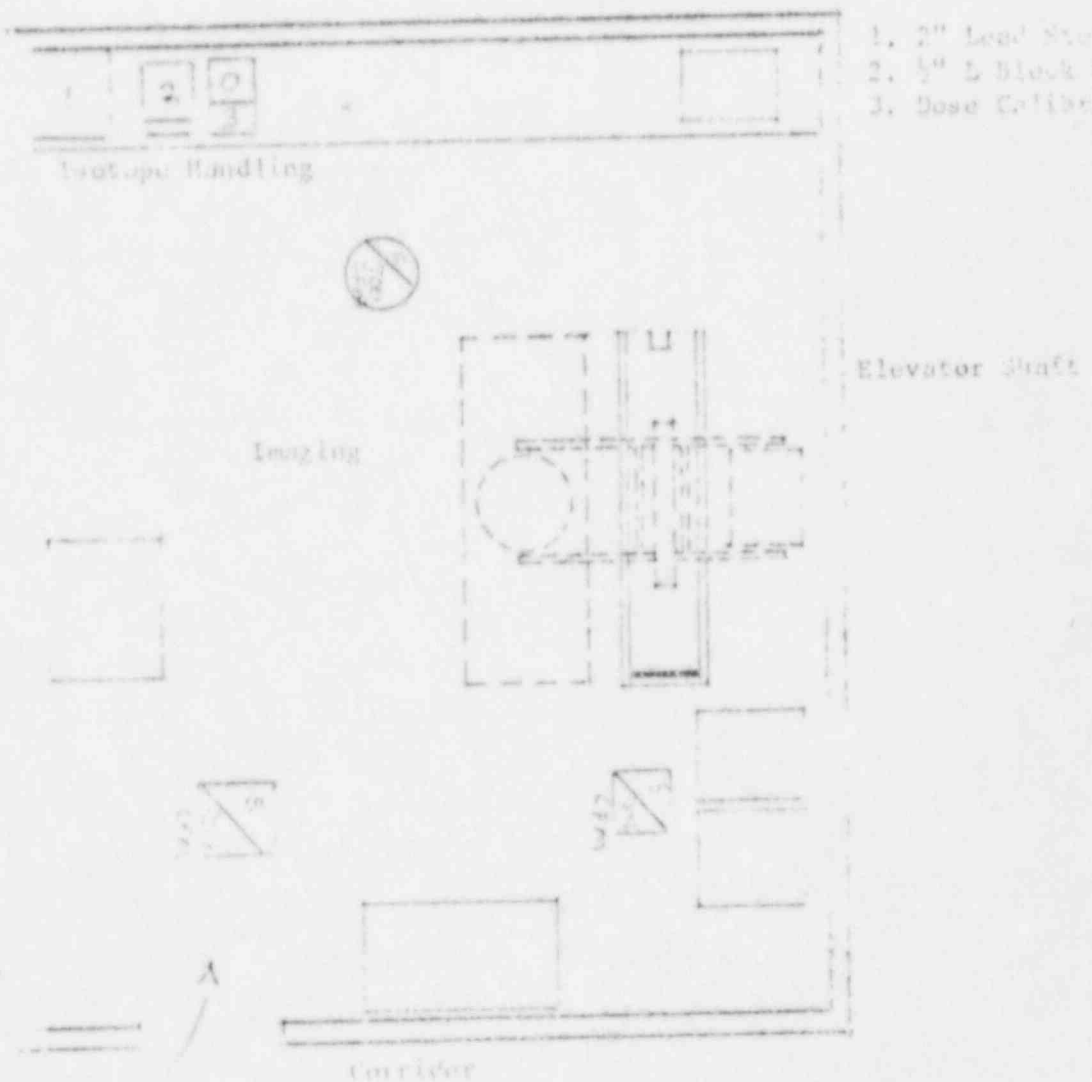
e. 2" x 4: lead bricks

f. work bench area with absorbent paper

g. ½" L block lead shield

The area designated HANDLING AREA will be used for receipt, storage (including waste), preparation and measurement of radioactive material. Radioactive waste will be stored in the lead brick storage area in labeled containers. The ENTIRE AREA will be locked when nuclear medicine personnel are off duty and will be made available only to those people authorized by Nuclear Medicine. All radiopharmaceuticals are stored in their shipping containers or in the two-inch thick lead storage area in the HANDLING AREA.

Nuclear Radiology Laboratory



PERSONNEL TRAINING PROGRAM

NUCLEAR MEDICINE TECHNOLOGIST

These individuals will be registered or registry eligible technologists by their respective registry group at this time, ARPT or ASCP.

HOUSEKEEPING, NUCLEAR MEDICINE TECHNOLOGIST, and SECURITY PERSONNEL

These individuals will be required to attend lectures before assuming their duties with or in the vicinity of radioactive materials, annually for refresher training, and whenever there is a significant change in duties, regulations or terms of the license. Lectures for presentation of this material will be two hours in duration. The training program will be of sufficient scope to insure that all personnel will receive proper instruction in the items specified in Section 19:12 of 10 CFR, Part 19 and will include:

A. Areas where radioactive material is used or stored
B. Potential hazards associated with radioactive materials
C. Radiological safety procedures appropriate to their respective duties
D. Pertinent NRC Regulations
E. The rules and regulations of the license
F. The pertinent terms of the license
G. Their obligation to report unsafe conditions.
H. Appropriate response to emergencies and unsafe conditions
I. Their right to be informed of their radiation exposure and bio-assay results

Lectures will be given by the Nuclear Medicine Technologist, the radiation safety officer or a consulting physicist. Parts 19 and 20 of 10 CFR Regulatory Guide 10.8, Rev. _____, Dated 1/79, "A Guide for Preparation of Applications for Medical Programs" will be used as source material for these lectures.

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 dtermined 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.

APPENDIX F

PROCEDURES FOR SAFELY OPENING PACKAGES CONTAINING RADIOACTIVE MATERIAL

1. Special requirements will be followed for packages containing quantities of radioactive material in excess of the Type A quantity limits as specified in paragraphs 20.205(a)(1) and (c)(1) of 10 CFR Part 20 (more than 20 Ci for Mo-99 and Tc-99m). They will be monitored for surface contamination and external radiation levels within 3 hours after receipt if received during working hours or within 18 hours if received after working hours, in accordance with the requirements of paragraphs 20.205(a) through (c). All shipments of liquids greater than exempt quantities will be tested for leakage. The NRC Regional Office will be notified in accordance with the regulations if removable contamination exceeds 0.01 μCi/100 cm^2 or if external radiation levels exceed 200 mR/hr at the package surface or 10 mR/hr at 3 feet (or 1 m).

2. For all packages, the following additional procedures for opening packages will be carried out:

   a. Put on gloves to prevent hand contamination.

   b. Visually inspect package for any sign of damage (e.g., wetness, crushed). If damage is noted, stop procedure and notify Radiation Safety Officer.

   c. Measure exposure rate at 3 feet (or 1 m) from package surface and record. If >10 mR/hr, stop procedure and notify Radiation Safety Officer.

   d. Measure surface exposure rate and record. If >200 mR/hr, stop procedure and notify Radiation Safety Officer.

   e. Open the package with the following precautionary steps:

      (1) Open the outer package (following manufacturer's directions, if supplied) and remove packing slip.

      (2) Open inner package and verify that contents agree with those on packing slip. Compare requisition,* packing slip, and label on bottle.

      (3) Check integrity of final source container (i.e., inspect for breakage of seals or vials, loss of liquid, and discoloration of packaging material).

      (4) Check also that shipment does not exceed possession limits.

   f. Wipe external surface of final source container shield and remove wipe to low background area. Check wipes with a thin-end-window G-M survey meter, and take precaution against the spread of contamination as necessary.

   g. Monitor the packing material and packages for contamination before discarding.

      (1) If contaminated, treat as radioactive waste.

      (2) If not contaminated, obliterate radiation labels before discarding in regular trash.

3. Maintain records of the results of checking each package, using "Radioactive Shipment Receipt Record" (see next page) or a form containing the same information.

---

*In the case of special orders (e.g., therapy doses), also compare with physician's written request.

APPENDIX G

GENERAL RULES FOR SAFE USE OF RADIOACTIVE MATERIAL

1. Wear laboratory coats or other protective clothing at all times in areas where radioactive materials are used.

2. Wear disposable gloves at all times while handling radioactive materials.

3. Monitor hands and clothing for contamination after each procedure or before leaving the area.

4. Always use syringe shields for routine preparation of patient doses and administration to patients, except in circumstances such as pediatric cases when their use would compromise the patient's well-being. In these exceptional cases, use other protective methods such as remote delivery of the dose (e.g., through use of a butterfly valve).

5. a. Do not eat, drink, smoke, or apply cosmetics in any area where radioactive material is stored or used.

   b. Do not store food, drink, or personal effects with radioactive material.

6. a. Assay each patient dose in the dose calibrator prior to administration. Do not use any doses that differ from the prescribed dose by more than 10 percent.

   b. For therapeutic doses, also check the patient's name, the radionuclide, the chemical form, and the activity vs. the order written by the physician who will perform the procedure.

7. Wear personnel monitoring devices (film badge or TLD) at all times while in areas where radioactive materials are used or stored. These devices should be worn at chest or waist level. Personnel monitoring devices when not being worn to monitor occupational exposures should be stored in a designated low background area.

8. Wear TLD finger badges during elution of generator and preparation, assay, and injection of radiopharmaceuticals.

9. Dispose of radioactive waste only in specially designated and properly shielded receptacles.

10. Never pipette by mouth.

11. Survey generator, kit preparation, and injection areas for contamination after each procedure or at the end of the day. Decontaminate if necessary.

12. Confine radioactive solutions in covered containers plainly identified and labeled with name of compound, radionuclide, date, activity, and radiation level, if applicable.

13. Always transport radioactive material in shielded containers.

APPENDIX H

EMERGENCY PROCEDURES

Minor Spills

1. NOTIFY: Notify persons in the area that a spill has occurred.

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

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

4. SURVEY: With a low-range, thin-window G-M survey meter, check the area around the spill, hands, and clothing for contamination.

5. REPORT: Report incident to the Radiation Safety Officer.

Major Spills

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

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

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

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

5. CALL FOR HELP: Notify the Radiation Safety Officer immediately.

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

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

*ALTERNATE NAMES AND TELEPHONE NUMBERS DESIGNATED BY RADIATION SAFETY OFFICER:

_____
_____
_____

*On the actual copy that is posted in the nuclear medicine department, this information will be filled in and updated as necessary.

APPENDIX I

AREA SURVEY PROCEDURES

1. All elution, preparation, and injection areas will be surveyed daily with an appropriately low-range survey meter and decontaminated if necessary.*

2. Laboratory areas where only small quantities of radioactive material are used (less than 200 μCi) will be surveyed monthly.

3. Waste storage areas and all other laboratory areas will be surveyed weekly.

4. The weekly and monthly surveys will consist of:

   a. A measurement of radiation levels with a survey meter sufficiently sensitive to detect 0.1 mR/hr.

   b. A series of wipe tests to measure contamination levels. The method for performing wipe tests will be sufficiently sensitive to detect 200 dpm per 100 cm^2 for the contaminant involved. Wipes of elution and preparation areas or other "high background" areas will be removed to a low background area for measurement.

5. A permanent record will be kept of all survey results, including negative results. The record will include:

   a. Location, date, and identification of equipment used, including the serial number and pertinent counting efficiencies.

   b. Name of person conducting the survey.

   c. Drawing of area surveyed, identifying relevant features such as active storage areas, active waste areas, etc.

   d. Measured exposure rates, keyed to location on the drawing (point out rates that require corrective action).

   e. Detected contamination levels, keyed to locations on drawing.

   f. Corrective action taken in the case of contamination or excessive exposure rates, reduced contamination levels or exposure rates after corrective action, and any appropriate comments.

6. Area will be cleaned if the contamination level exceeds 200 dpm/100 cm^2.

* For daily surveys where no abnormal exposures are found, only the date, the identification of the person performing the survey, and the survey results will be recorded.

APPENDIX J

WASTE DISPOSAL

Note: In view of the recent problems with shallow-land burial sites used by commercial waste disposal firms, NRC is encouraging its licensees to reduce the volume of wastes sent to these facilities. Important steps in volume reduction are to segregate radioactive from nonradioactive waste, to hold short-lived radioactive waste for decay in storage, and to release certain materials in the sanitary sewer in accordance with §20.303 of 10 CFR Part 20.

1. Liquid waste will be disposed of (check as appropriate)

X — In the sanitary sewer system in accordance with §20.303 of 10 CFR Part 20.

-or-

N/A — By commercial waste disposal service (see also Item 4 below).

X — Other (specify): See #3

2. Mo-99/Tc-99m generators will be (check as appropriate)

_____ Returned to the manufacturer for disposal.

-or-

_____ Held for decay* until radiation levels, as measured in a low background area with a low-level survey meter and with all shielding removed, have reached background levels. All radiation labels will be removed or obliterated, and the generators will be disposed of as normal trash.**

3. Other solid waste will be (check as appropriate)

X — Held for decay* until radiation levels, as measured in a low background area with a low-level survey meter and with all shielding removed, have reached background levels. All radiation labels will be removed or obliterated, and the waste will be disposed of in normal trash.

N/A — Disposed of by commercial waste disposal service (see also Item 4 below).

N/A — Other (specify): _____

4. The commercial waste disposal service used will be

N/A

(Name) (City, State)

NRC/Agreement State License No. N/A

---

* Be sure that waste storage areas were described in Item 11 and that they are surveyed periodically (Item 17).

** These generators may contain long-lived radioisotopic contaminants. Therefore, the generator columns will be segregated so that they may be monitored separately to ensure decay to background levels prior to disposal.

Procedures and Precautions for use of 133-Xenon

1. Quantities to be used

   a. 5 Studies per week

   b. 10 mCi per patient

   c. possession limit of 250 mCi

2. Use and storage area

   a. Please see the attached diagram of the Nuclear Radiology area. Sources will be stored until use in their shipping containers in the 2" thick lead storage area. The 133-Xenon system will be stored adjacent to the Isotope Handling area when not being used. The nearest unrestricted area is 21 feet away.

   b. Ventillation information

      This lab is located on the top floor of a 9 story building. Two vents supply 650 CFM of air to this room. An exhaust system has been installed directly from the ceiling to the roof of the building and is exclusive for this room. The rate of exhaust is 700 CFM. There are no return vents in this room and the walls of the room extend above the ceiling to the poured concrete roof. Therefore: Supply : 650 CFM
      Exhaust: 700 CFM
      % air recirculated: 0

The nearest window is approximately 60 feet from the exhaust vent and there are no air intake vents in the area of the exhaust vent.

   c. This room will be under negative pressure relative to the corridor. To insure that all airflow rates will be maintained, periodic preventive maintenance checks will be performed by the building engineering department.

Should be semi-annual

3. Procedures for routine use

   a. See the attached brochure for routine use.

   b. See the attached brochure for description of the equipment to be used.

   c. The patient will breath through a face mask. For patients that cannot be fitted with a face mask, a nose clamp will be used to prevent exhaling into the room.

4. Emergency procedures: In case of accidental release of 133-Xenon into the Nuclear Radiology area proceed as follows:

   a. Procure the survey meter, evacuate the area, and insure that the door to the area is closed (the low level survey meter shall be on hand and available as part of the equipment necessary while performing 133-Xe prodecures.)

b. Wait thirty (30) minutes and survey the area, the room area must have returned to background levels before work may be resumed. This 30 minute period is based on the room volume and the amount of air being exchanged and exhausted by the normal ventillation system.

5. Air concentration of 133-Xe

a. Restricted area

1. $A = \frac{10 mCi}{pt} \times \frac{5\ pt}{wk} = 50\ mCi/wk$

2. f = 20%

3. Ventillation Rate: 650 CFM Supply
700 CFM Exhaust

4. Sample Problem

$$V = \frac{50 \frac{mCi}{wk} \times 10 \frac{3 uCi}{mCi} \times 0.2}{1 \times 10^{5} \frac{uCi}{ml}} = 1 \times 10^{9} \frac{ml}{wk}$$

The required ventillation rate is:

$$\frac{1 \times 10^{9} \frac{ml}{wk}}{40 \frac{hr}{wk}} \times \frac{1\ CFM}{1.7 \times 10^{6}\ ml/hr} = 14.2\ CFM$$

The ventillation rate specified is 5 A-3 greatly exceeds the required amount.

6. Unrestricted area

a. 133-Xe concentration from exhaust vent (700 CFM). The exhaust rate from this area is 700 CFM. The air is vented directly from this area to the roof.

1. Maximum amount released per year:

$A = 50 mCi/wk \times 10^{3}\ uCi/mCi \times 0.2\ 52\ week/year = 5.2 \times 10^{5}\ uCi/yr$

2. Average concentration of 133-Xe released:

$$A = 5.2 \times 10^{5}\ uCi/yr$$
$$V = 700 \frac{ft^{3}}{min} \times 1.49 \times 10^{10} \frac{ml/yr}{ft\ 3/min} = 1.04 \times 10^{13} \frac{ml}{yr}$$

$$C = \frac{5.2 \times 10^{5} uCi/yr}{1.04 \times 10^{13} ml/yr} = 5.0 \times 10^{-8} \frac{uCi}{ml}$$

20.106 of 19 CFR Part 20 requires that:

$$C = \frac{A}{V} \leq 3 \times 10^{-7}\ uCi/ml$$

Please note that both calculations assume that the total amount lost is 20% since a 133-Xenon trap will be used.

b. Absorption onto Charcoal Traps

The charcoal trap will be checked prior to and after each procedure with the low level G.M. survey meter. The response to build up in the trap will be monitored at the trap exhaust port during the study. If there is a sudden increase in the radiation reading at the exhaust port, the procedure will be terminated and the emergency procedure implemented. If it is determined that the trap has saturated, it will be replaced.

Saturated filters will be handled and replaced in the HANDLING AREA using the manufacturer's suggested methods. Ample lead shielding (2" lead bricks) is available for storing the charcoal filters until they decay to background levels. The individual removing the filters from its shield will use lead gloves and wear a lead apron. The filters will be placed in double plastic bags and sealed. After decay to background levels the filters will be monitored and disposed of in the normal trash. Film and ring badges will be worn at all times.

Atomlab

INSTRUCTION MANUAL

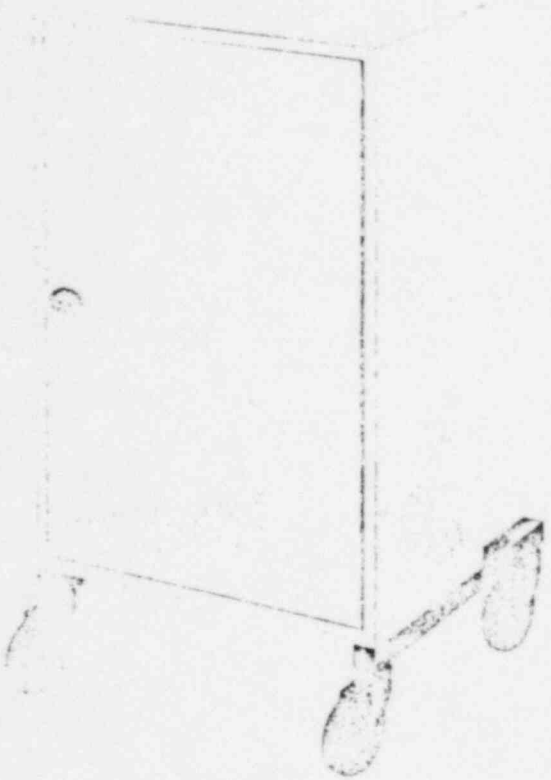
Model 130–500

PULMONEX XENON SYSTEM

Atomic Products Corporation

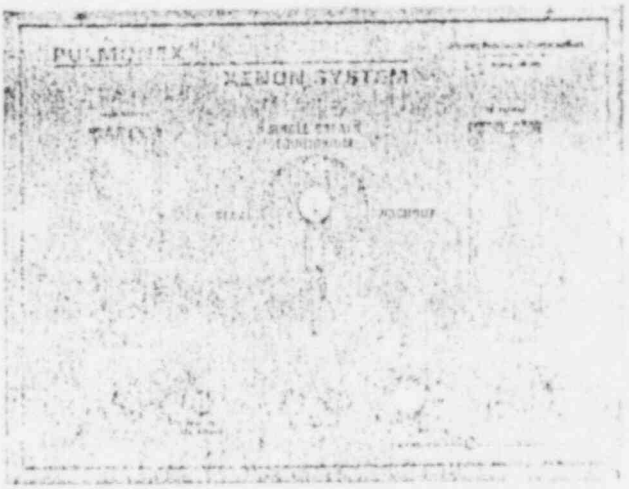
Center Moriches, New York 11934, U.S.A.
(516) 878-1074

PULMONEX XENON SYSTEM



COMPLETE XENON DELIVERY SYSTEM
WITH INTEGRATED
XENON GAS TRAP

ALL FUNCTIONS ARE CONTROLLED BY A SIMPLE HANDLE ON THE FRONT PANEL. ALL CONTROLS ARE CLEARLY MARKED FOR EASE OF OPERATION.



PULMONEX XENON SYSTEM
INSTRUCTIONS

To thoroughly familiarize yourself with the equipment and methodology, it is suggested that you run through the procedure several times; first without any patient, then with a colleague as a "patient" without actually using xenon. When you are completely familiar with the routine, you can start doing xenon studies on patients with confidence.

FOLLOW THESE SIMPLE STEPS CAREFULLY:

1. Open the top rear door. Inspect the interior. All hoses should be connected to their respective ports. Bags should be lying flat.
2. Open the lower front door. All hoses should be connected to their respective ports.
3. Remove the empty plastic cartridge that hangs from the top of the lower compartment. Fill the cartridge about half way with the blue drierite(139-101) and return the cartridge to the hose fittings. This serves as a moisture trap for the air going into the charcoal cartridge. Close the lower compartment. Replace the drierite when it changes color (from blue to pink). Failure to change the drierite will significantly shorten the life of the charcoal cartridge.
4. Remove the empty plastic cartridge that is within the top compartment. Fill half way with white granule soda-lime (available in your hospital pharmacy or respiratory service department). Return it to the hose fittings. This serves as a carbon dioxide trap. Close the top rear door. Change the soda-lime between each patient. Failure to change the soda-lime will cause the patient to rebreathe too much carbon dioxide, causing hypo-ventilation.
5. Bring the unit to the area of operation. Make sure the timer is on "0" and plug into a nearby electrical outlet.
6. At the rear of the unit, there are two white hose connections, side by side. Attach the breathing tube/bacteria filter/mouthpiece assembly to the hose connections. The plastic plug and warning label *must* be facing up. You can use longer tubes (supplied) for a supine patient. It is advisable to use hose clamps to tighten the hoses to the hose connections. At the rear of the unit, just below the overhang, is the trap final vent. Connect a hose from the trap vent to your room vent as a safety precaution.
7. Attach an oxygen tank to the oxygen inlet port on on the front panel. Clamp a ¼ inch oxygen hose to the port. Turn the oxygen valve to 5 PSI and leave on. Be sure to use only 5 lbs. pressure. Overloading the system with oxygen will pull the interior connections apart. If possible, use a pediatric regulator on the oxygen tank.
8. Position the patient in front of the scintillation camera. Using a source, see that both the lungs are within the crystal area.
9. Set the camera for Xe 133. Record all data on tape.
10. Place the Pulmonex as close to the patient as possible and set the handle to the start position. The number "one" will appear under the handle.
11. Set the air flow control to seventy (an arbitrary figure that can be changed to accommodate the patient's breathing pattern).
12. Set the timer at 9 minutes (an arbitrary figure that can be changed at any time depending on the study procedure you prefer).
13. Place the mouthpiece in the patient's mouth. Clip the patient's nose closed. Place a vertex cape on the patient.
14. Have the patient take a few breaths to become accustomed to breathing with a mouthpiece. Observe that the "from patient" bag will move slightly as the patient exhales.
15. Press the button on the front panel to add oxygen to the "to patient" bag. Only add a small amount of oxygen. Hold the button for a second or, at the most, two seconds. (The bag will only move slightly, do not fill it up). More oxygen can be added later if the patient requires. In many cases, it is possible not to add any oxygen and perform the entire study on ambient air. In all cases, the oxygen is only to enrich the air in the circuit.
16. Switch the handle to Single Breath, Equilibrium #2. With a NEN Gun or syringe filled with xenon, puncture the mouthpiece with the needle and add the xenon as you have the patient take a deep inspiration. Have the patient hold his breath for as long as possible and then continue to breathe normally. Advise the patient to breathe slowly and normally. Observe both breathing bags moving through the front panel windows. Add oxygen if the patient requires it. An alternative to puncturing the mouthpiece is to use the luer adapter plug provided.
17. When the patient reaches equilibrium (1 or 2 minutes, the counting rate on the camera stabilizes), switch to washout, #3. Take washout data on the camera (typical framing: first picture, 15 seconds; second, 30 seconds; third 60 seconds). Have the patient breathe normally slowly.
18. Carefully watch the "from patient" bag. If it blows up tight, the patient is breathing too fast. Advise him to normalize his breathing and increase the air flow speed. If the bag continues to expand against the glass, the patient will feel back pressure and resistance. To relieve this effect, open the lower cabinet. On the upper side there is a motor control. Turn it clockwise until the breathing bag becomes more flacid. Return the control to about ⅓ of its range. The use of the motor control will be a rare occurence. Do not adjust it unless it is absolutely necessary. If it is used, be sure to return it to its original position. To be effective, the increase in motor speed must be done immediately, so watch the "from patient" bag carefully during washout.
19. When the washout is complete, remove the patient and let the system run for a few more seconds or until both bags are empty.

TESTING THE GAS TRAP

1. Trap effluent exits from the port located just beneath the overhang.
2. A general trap test should be performed once a week.
3. Fill two plastic bags or balloons with trap effluent. One at the beginning of washout, one toward the end of washout.
4. Use the scintillation detector to determine if the samples are significantly above background.

PULMONEX ACCESSORIES

MODEL	DESCRIPTION	PRICE
130-550	Mouthpiece	$1.00 ea.
130-545	8" hose	.25 ea.
130-543	39" hose	.75 ea.
130-555	Extra trap cartridge for Drierite or soda lime	1.25 ea.
139-101	Drierite	4.30/lb.
130-800	Disposable Bacteria Filter	3.50 ea.
139-102	Extra "Y" manifold with one-way valve	5.00 ea.
130-019	Soda Lime CO_2 Abosrber	2.00/lb.

Atomlab

Atomic Products Corporation
Center Moriches, New York 11934, U.S.A.
(516) 878-1074

APPENDIX O

MODEL PROGRAM FOR MAINTAINING OCCUPATIONAL RADIATION EXPOSURES AT MEDICAL INSTITUTIONS ALARA

_____

(Licensee's Name)

_____

(Date)

1. **Management Commitment**

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

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

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

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

2. **Radiation Safety Committee (RSC)[2]**

   a. Review of Proposed Users and Uses

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

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

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

   b. Delegation of Authority

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

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

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

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

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

c. Review of ALARA Program

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

(2) The RSC will perform a quarterly review of occupational radiation exposure with particular attention to instances where Investigational Levels in Table 0-1 below are exceeded. The principal purpose of this review is to assess trends in occupational exposure as an index of the ALARA program quality and to decide if action is warranted when Investigational Levels are exceeded (see Section 6).[3]

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

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

a. Annual and Quarterly Review

(1) Annual review of the radiation safety program. The RSO will perform an annual review of the radiation safety program for adherence to ALARA concepts. Reviews of specific procedures may be conducted on a more frequent basis.

(2) Quarterly review of occupational exposures. The RSO will review at least quarterly the external radiation exposures of authorized users and workers to determine that their exposures are ALARA in accordance with the provisions of Section 6 of this program.

(3) Quarterly review of records of radiation level surveys. The RSO will review radiation levels in unrestricted and restricted areas to determine that they were at ALARA levels during the previous quarter.

b. Education Responsibilities for ALARA Program

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

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

c. Cooperative Efforts for Development of ALARA Procedures

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

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

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

d. Reviewing Instances of Deviation from Good ALARA Practices

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

4. **Authorized Users**

a. New Procedures Involving Potential Radiation Exposures

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

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

b. Responsibility of Authorized User to Persons Under His/Her Supervision

(1) The authorized user will explain the ALARA concept and his/her commitment to maintain exposures ALARA to all persons under his/her supervision.

(2) The authorized user will ensure that persons under his/her supervision who are

---

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

subject to occupational radiation exposure are trained and educated in good health physics practices and in maintaining exposures ALARA.

5. **Persons Who Receive Occupational Radiation Exposure**

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

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

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

   This institution (or private practice) hereby establishes Investigational Levels for occupational external radiation exposure which, when exceeded, will initiate review or investigation by the RSC and/or the RSO. The Investigational Levels that we have adopted are listed in Table 0-1 below. These levels apply to the exposure of individual workers.

Table 0-1

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

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

The Radiation Safety Officer will review and record on Form NRC-5, "Current Occupational External Radiation Exposures," or an equivalent form (e.g., dosimeter processor's report), results of personnel monitoring not less than once in any calendar quarter as required by §20.401 of 10 CFR Part 20. The following actions will be taken at the Investigational Levels as stated in Table 0-1:

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

   Except when deemed appropriate by the RSO, no further action will be taken in those cases where an individual's exposure is less than Table 0-1 values for the Investigational Level I.

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

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

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

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

d. Reestablishment of an individual occupational worker's Investigational Level II to a level above that listed in Table 0-1.

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

   The RSC will review the justification for, and will approve, all revisions of Investigational Level II. In such cases, when the exposure equals or exceeds

the newly established Investigational Level II, those actions listed in paragraph 6.c above will be followed.

7. **Signature of Certifying Official**[4]

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

Rodger W. Lambie MD

Signature

Rodger W. Lambie, M.D.

Name (print or type)

President, Radiologists, Inc.

Title

Institution (or Private Practice) Name and Address:

Radiologists, Inc.
6724 Troost, Suite 900
Kansas City, Missouri 64131

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

APPENDIX A

1. Type of Unit

   a) Manufacturer: Lunar Radiation Corporation (or equivalent)
   b) Model Number: DP3 Bone Scanner

2. Source used and possession limit

   a) 153-Gadolinium/1.5 curie
   b) 125-Iodine/500 millicuries

3. Physicians as authorized users

   See item 8 page 7.

4. Physician Training

   The training will be on site for two days, device specific. It will cover safety, source exchange, wipe testing, normal daily operation, positioning, and interpretation.

5. The unit will be stored in an imaging room with the room secured during non-working hours.

6. The source will be inventoried quarterly and wipe tested semi-annually. The wipe test will be counted in a Picker Spectroscaler 4 Well Counter. The documentation of its sensitivity shows capability of counting activities less than .005 microcuries.

7. Procedures

   See Appendix B.

BONE MINERAL ANALYSIS: SPINE

Rationale: Dual-photon absorpitometry (DPA) enables a quantitative assessment of skeletal bone mineral in regions of the body that were previously inaccessible using single photon absorptiometry. The use of two photon energies minimizes errors that result from irregular body coutour and soft-tissue inhomogenities. In theory, in order to analyze a given number of substances, attenuation measurements at the same number of discrete photon energies are required, since the simultaneous equations obtained by applications of Lambert's Law can be solved only if there are as many independent equations as unknowns. Since the attenuation coefficients are correlated, the number of substances that can be determined is limited. Two photon energies therefore allow discrimination of two substances in a given system. If only two substances are present the technique is capable of high accuracy. In the case where more than two substances are present, the accuracy with which the two substances of interest can be measured depends on the number of additional substances, their attenuation characteristics and fraction of the total which they represent.

Clinically, a two-component system can be defined as consisting of bone mineral and soft-tissues. The photon energies are 44 and 100 keV since these are currently the most commonly used energies for dual photon scanning. These low energy photons enable detection of very small changes in the two component system.

Determining the Bone Mineral Content (BMC) is useful for diagnostic applications since it is usually people with small and osteopenic spines who fracture. Osteoporitic patients typically are at least 30% below controls in BMC. The total BMD (BMC per unit projected scan area) normalizes BMC for bone size in g/cm2. The BMD is typically 30% below controls in osteoporotic patients. BMD is most useful for serial measurements on the same individual over time since variation due to exact repositioning is minimized. Similarly the Central Density (determined in the central centimeter of the centrum) is useful for serial determinations; it is less influenced by choice of centrum edges and hence can provide more reliable long-term results.

Bone mineral will be expressed as grams (BMC), grams per centimeter-squared (BMD), and area will be expressed in centimeters-squared. The "central

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Bone mineral will be expressed as grams (BMC), grams per centimeter-squared (BMD), and area will be expressed in centimeters-squared. The "central

density" (g/cm2) for a 1cm wide strip through the center of the chosen vertebrae will be displayed. The Corpus Density is given in mg/cc; this is the calculated density of the vertebral body BMD. The algorithm used takes half of the bone (and area) of the preceding line and succeeding line as well as the bone (and area) within the limits.

Procedure:

To Boot up System:

1. Turn knob upper left corner back of computer to increase brightness on computer screen.
2. Insert North Star Compiled Programs Versions 7C (face up) into Disk Drive 1 (Upper slot).
3. Insert initialized disk into Disk Drive 2 (Lower slot).
4. Return - to boot up system.

To Peak Detector (Once very 2 weeks:)

1. Turn printer on (Power on left side). Press "On Line" on printer.
2. Set switch on amplifier (Under table on right) to DPE.
3. Choose OPTION 4 - PEAK Detector. Have standard in position with gold tab facing up and toward scanner arm.

   Type date and previous amplifier setting.
4. Set amplifier dial to readings requested. Computer will calculate peak.
5. Set amplifier to determined setting.
6. Print peaking graph and statistics and file.
7. Enter peak value on log sheet.

To Scan Standard and Quality Control:

1. Turn printer on and press "On Line" button.
2. Set switch on amplifier to DPE.
3. Choose OPTION 3 - Scan Standard and QA
4. Check for source light under table.

5. QC tests and scan of standard will be done automatically. If any test fails, repeat peak and QC tests again (CNT C will stop standard scan if tests need to be repeated) It takes about 15 minutes to scan standard and do QC tests.

6. Enter air values and standard scan values on log sheet. %CV should be less than 3.0.

7. Print, save and file QC tests and standard scans in QC file folder.

To Scan Patient:

1. Verify that an initialized diskette in in drive #2

2. Choose OPTION 1: Patient Scan

3. Enter patient data.

4. Choose scan type: Normal

5. Choose number of scan lines: 40

6. Position patient using square pillow under legs. If the patient is too thick to fit under the detector, move detector up. IMPORTANT: Standard will need to be scanned with detector in this position.

7. Enter standard values. Use values obtained from average of previous weeks' standard scans. See log sheet for these values (QC File). Remember: If detector is moved up from 28cm, standard scans will need to be done at that height.

8. Patient will be scanned. This takes approximately 45 minutes. When screen says "Scan Finished", you may help patient from table.

To Analyze Data:

1. Examine the edge selection and print on hard copy to turn in with requisition to Reading Room. Edges are shown with the letter C.

2. Examine the screen image to identify L2-L4. Record the scan lines that correspond to that region of interest. When analyzing L-2 - L-4, do not include the intervertebral space between L-1 and L-2 or between L-4 and L-5.

3. Enter first limit. Input the scan line number corresponding to the most inferior extent of L-4.

4. Enter Second Limit. Input the scan line number corresponding to the most superior extent of L-2.

5. Select Region 7, L1 - L4. Select this region even though we used L2 - L4 to analyze.

6. The computer will calculate and display the bone mineral content of density for L-2, L-3, L-4 vertebrae.

7. Print the output data.

Note: Cnt C will stop a program and return to Option Page.

Four Key break (command, shift left, shift right, back space) will stop program and return to Load System.

NRC FORM 313M SUPPLEMENT A (9-81) U.S. NUCLEAR REGULATORY COMMISSION

TRAINING AND EXPERIENCE
AUTHORIZED USER OR RADIATION SAFETY OFFICER

1. NAME OF AUTHORIZED USER OR RADIATION SAFETY OFFICER	2. STATE OR TERRITORY IN WHICH LICENSED TO PRACTICE MEDICINE
Curtis Scott Hammerman, M.D.	Kansas/Missouri

3. CERTIFICATION

SPECIALTY BOARD A	CATEGORY B	MONTH AND YEAR CERTIFIED C
Board Eligible American College of Radiology		

4. TRAINING RECEIVED IN BASIC RADIOISOTOPE HANDLING TECHNIQUES

FIELD OF TRAINING A	LOCATION AND DATE(S) OF TRAINING B	TYPE AND LENGTH OF TRAINING	
		LECTURE/ LABORATORY COURSES (Hours) C	SUPERVISED LABORATORY EXPERIENCE (Hours) D
a. RADIATION PHYSICS AND INSTRUMENTATION	(6-1-84 to 9/30/84) Mallinckrodt Institute St. Louis, Missouri	90	
b. RADIATION PROTECTION	Same	20	
c. MATHEMATICS PERTAINING TO THE USE AND MEASUREMENT OF RADIOACTIVITY	Same	20	
d. RADIATION BIOLOGY	Same	20	
e. RADIOPHARMACEUTICAL CHEMISTRY	Same	30	

5. EXPERIENCE WITH RADIATION. *(Actual use of Radioisotopes or Equivalent Experience)*

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION OF EXPERIENCE	TYPE OF USE

FORM NRC-313M-SUPPLEMENT B
(8-78)

U. S. NUCLEAR REGULATORY COMMISSION

PRECEPTOR STATEMENT

Supplement B must be completed by the applicant physician's preceptor. If more than one preceptor is necessary to document experience, obtain a separate statement from each.

1. APPLICANT PHYSICIAN'S NAME AND ADDRESS

FULL NAME: Curtis Hammerman, M.D.

STREET ADDRESS: 9017 W. 101st Terr.

CITY: Overland Park | STATE: Ks. | ZIP CODE: 66212

KEY TO COLUMN C

PERSONAL PARTICIPATION SHOULD CONSIST OF:

1-Supervised examination of patients to determine the suitability for radioisotope diagnosis and/or treatment and recommendation for prescribed dosage.

2-Collaboration in dose calibration and actual administration of dose to the patient including calculation of the radiation dose, related measurements and plotting of data.

3-Adequate period of training to enable physician to manage radioactive patients and follow patients through diagnosis and/or course of treatment.

2. CLINICAL TRAINING AND EXPERIENCE OF ABOVE NAMED PHYSICIAN

ISOTOPE A	CONDITIONS DIAGNOSED OR TREATED B	NUMBER OF CASES INVOLVING PERSONAL PARTICIPATION C	COMMENTS *(Additional information or comments may be submitted in duplicate on separate sheets.)* D
I-131 or I-125	DIAGNOSIS OF THYROID FUNCTION	4	
	DETERMINATION OF BLOOD AND BLOOD PLASMA VOLUME	1	
	LIVER FUNCTION STUDIES	0	
	FAT ABSORPTION STUDIES	0	
	KIDNEY FUNCTION STUDIES	19	
	IN VITRO STUDIES	0	
OTHER		0	
I-125	DETECTION OF THROMBOSIS	1	
I-131	THYROID IMAGING	0	
P-32	EYE TUMOR LOCALIZATION	0	
Se-75	PANCREAS IMAGING	0	
Yb-169	CISTERNOGRAPHY	0	
Xe-133	BLOOD FLOW STUDIES AND PULMONARY FUNCTION STUDIES	39	
OTHER			
Tc-99m	BRAIN IMAGING	15	
	CARDIAC IMAGING	22	
	THYROID IMAGING	17	
	SALIVARY GLAND IMAGING	1	
	BLOOD POOL IMAGING	164	
	PLACENTA LOCALIZATION	0	
	LIVER AND SPLEEN IMAGING	58	
	LUNG IMAGING	39	
	BONE IMAGING	85	
OTHER			

PRECEPTOR STATEMENT *(Continued)*

2. CLINICAL TRAINING AND EXPERIENCE OF ABOVE NAMED PHYSICIAN *(Continued)*

ISOTOPE A	CONDITIONS DIAGNOSED OR TREATED B	NUMBER OF CASES INVOLVING PERSONAL PARTICIPATION C	COMMENTS *(Additional information or comments may be submitted in duplicate on separate sheets.)* D
P-32 *(Soluble)*	TREATMENT OF POLYCYTHEMIA VERA, LEUKEMIA, AND BONE METASTASES	0	
P-32 *(Colloidal)*	INTRACAVITARY TREATMENT	0	
I-131	TREATMENT OF THYROID CARCINOMA	0	
	TREATMENT OF HYPERTHYROIDISM	1	
Au-198	INTRACAVITARY TREATMENT	0	
Co-60 or Cs-137	INTERSTITIAL TREATMENT	0	
	INTRACAVITARY TREATMENT	0	
I-125 or Ir-192	INTERSTITIAL TREATMENT	0	
Co-60 or Cs-137	TELETHERAPY TREATMENT	0	
Sr-90	TREATMENT OF EYE DISEASE	0	
	RADIOPHARMACEUTICAL PREPARATION		
Mo-99/ Tc-99m	GENERATOR	2	
Sn-113/ In-113m	GENERATOR	0	
Tc-99m	REAGENT KITS	2	
Other			
Co-57	Schilling Test	2	
Co-58	Schilling Test	2	
Cr-51	Red Blood Cell Labeling	1	
Ga-67	Inflammatory Process & Tumor Imaging	6	
Tl-201	Myocardial Imaging	32	
In-111	Cisternography	2	

3. DATES AND TOTAL NUMBER OF HOURS RECEIVED IN CLINICAL RADIOISOTOPE TRAINING

22 November - 19 December 1982 (168 hours) during the course of an integrated residency training program in diagnostic radiology.

4. THE TRAINING AND EXPERIENCE INDICATED ABOVE WAS OBTAINED UNDER THE SUPERVISION OF:

a. NAME OF SUPERVISOR
Barry A. Siegel, M.D.

b. NAME OF INSTITUTION
Mallinckrodt Institute of Radiology

c. MAILING ADDRESS
510 S. Kingshighway Blvd.

d. CITY
St. Louis, MO 63110

5. MATERIALS LICENSE NUMBER(S)
24-00167-11

6. PRECEPTOR'S SIGNATURE
Barry a Siegel

7. PRECEPTOR'S NAME *(Please type or print)*
Barry A. Siegel, M.D.

8. DATE
3 September 1985

FORM NRC-313M-SUPPLEMENT B
(8-78)

FORM NRC-313M-SUPPLEMENT B
(8-78)

U. S. NUCLEAR REGULATORY COMMISSION

PRECEPTOR STATEMENT

Supplement B must be completed by the applicant physician's preceptor. If more than one preceptor is necessary to document experience, obtain a separate statement from each.

1. APPLICANT PHYSICIAN'S NAME AND ADDRESS

FULL NAME

Curtis Hammerman, M.D.

STREET ADDRESS

9017 W. 101st. Terr.

CITY	STATE	ZIP CODE
Overland Park	ks.	66212

KEY TO COLUMN C

PERSONAL PARTICIPATION SHOULD CONSIST OF:

1-Supervised examination of patients to determine the suitability for radioisotope diagnosis and/or treatment and recommendation for prescribed dosage.

2-Collaboration in dose calibration and actual administration of dose to the patient including calculation of the radiation dose, related measurements and plotting of data.

3-Adequate period of training to enable physician to manage radioactive patients and follow patients through diagnosis and/or course of treatment.

2. CLINICAL TRAINING AND EXPERIENCE OF ABOVE NAMED PHYSICIAN

ISOTOPE A	CONDITIONS DIAGNOSED OR TREATED B	NUMBER OF CASES INVOLVING PERSONAL PARTICIPATION C	COMMENTS *(Additional information or comments may be submitted in duplicate on separate sheets.)* D
I-131 or I-125	DIAGNOSIS OF THYROID FUNCTION	27	
	DETERMINATION OF BLOOD AND BLOOD PLASMA VOLUME	2	
	LIVER FUNCTION STUDIES	0	
	FAT ABSORPTION STUDIES	0	
	KIDNEY FUNCTION STUDIES	35	
	IN VITRO STUDIES	0	
OTHER			
I-125	DETECTION OF THROMBOSIS	4	
I-131	THYROID IMAGING	72	
P-32	EYE TUMOR LOCALIZATION	0	
Se-75	PANCREAS IMAGING	0	
Yb-169	CISTERNOGRAPHY	1	
Xe-133	BLOOD FLOW STUDIES AND PULMONARY FUNCTION STUDIES	192	
OTHER			
Tc-99m	BRAIN IMAGING	7	
	CARDIAC IMAGING	23	
	THYROID IMAGING	38	
	SALIVARY GLAND IMAGING	1	
	BLOOD POOL IMAGING	241	
	PLACENTA LOCALIZATION	0	
	LIVER AND SPLEEN IMAGING	109	
	LUNG IMAGING	228	
	BONE IMAGING	281	
OTHER			

PRECEPTOR STATEMENT *(Continued)*

2. CLINICAL TRAINING AND EXPERIENCE OF ABOVE NAMED PHYSICIAN *(Continued)*

ISOTOPE A	CONDITIONS DIAGNOSED OR TREATED B	NUMBER OF CASES INVOLVING PERSONAL PARTICIPATION C	COMMENTS *(Additional information or comments may be submitted in duplicate on separate sheets.)* D
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P-32 *(Colloidal)*	INTRACAVITARY TREATMENT	0	
I-131	TREATMENT OF THYROID CARCINOMA	0	
	TREATMENT OF HYPERTHYROIDISM	7	
Au-198	INTRACAVITARY TREATMENT	0	
Co-60 or Cs-137	INTERSTITIAL TREATMENT	0	
	INTRACAVITARY TREATMENT	0	
I-125 or Ir-192	INTERSTITIAL TREATMENT	0	
Co-60 or Cs-137	TELETHERAPY TREATMENT	0	
Sr-90	TREATMENT OF EYE DISEASE	0	
	RADIOPHARMACEUTICAL PREPARATION		
Mo-99/ Tc-99m	GENERATOR	0	
Sn-113/ In-113m	GENERATOR	0	
Tc-99m	REAGENT KITS	0	
Other			

3. DATES AND TOTAL NUMBER OF HOURS RECEIVED IN CLINICAL RADIOISOTOPE TRAINING

Three months (Sept. 1983, May 1984, Jan. 1985) of training in Nuclear Medicine (428 hours) was provided during Dr. Hammerman's Diagnostic Radiology Residency.

4. THE TRAINING AND EXPERIENCE INDICATED ABOVE WAS OBTAINED UNDER THE SUPERVISION OF:

a. NAME OF SUPERVISOR
Keith C. Fischer, M.D.

b. NAME OF INSTITUTION
The Jewish Hospital of St. Louis

c. MAILING ADDRESS
216 S. Kingshighway

d. CITY
St. Louis, MO. 63108

5. MATERIALS LICENSE NUMBER(S)

24-00167-11

6. PRECEPTOR'S SIGNATURE

Keith C. Fischer, MD

7. PRECEPTOR'S NAME *(Please type or print)*

Keith C. Fischer, M.D.

8. DATE

September 9, 1985

FORM NRC-313M-SUPPLEMENT B
(8-78)