Medical Center Salt Lake City UT 84148 476

Veterans Administration

March 15, 1983

In Reply Refer To: 115

Mr. Francis A. St. Mary
Material Licensing Branch
Division of Fuel Cycle and Material Safety
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

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Thru: James J. Smith, M.D.
Director, Nuclear Medicine
VA Central Office

Docket No. 030-03273
License No. 43-03299-01
Control No. 12206 and 00407

cancelled and combined with 00407

Dear Mr. St. Mary

The attached information refers to our original application for amendment dated 5-6-82, your request for information dated 9-2-82, and your further request dated 11-16-82. We have chosen to resubmit the supporting information in total, reflecting the new wing in which Nuclear Medicine is now housed, and all appropriate procedures for the use of Xenon 133. As mentioned in section G (attached), the ventillation rates shown are specified, not measured. This area of new construction will not be accepted, however, until the specified rates are met.

This same information is also being sent to Mr. Rod Mason for inclusion in our broad license application which he is reviewing.

Sincerely

R.E. Lindsey, Jr.
Medical Center Director

James J. Smith MD

JAMES J. SMITH, M. D. (115)
Director, Nuclear Medicine Service
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PROCEDURES AND PRECAUTIONS FOR USE OF RADIOACTIVE GASES

A. Quantities Used

An average of seven studies per week are expected. Xenon-133 will be used. The system is a rebreathing system loaded with approximately 100 mCi of Xe-133. The same 100 mCi will be reused on a number of patients and the total amount of Xe-133 brought i' to the lab per week is expected to be less than 200 mCi.

B. Use and Storage Area

Xenon-133 is received from Intermountain Radiopharmacy (NRC license 43-01884-01) on an as needed basis. Xenon is stored for use in the rebreathing system which is a RADX Ventil-Con II. The Ventil-Con II will normally contain approximately 100 mCi of Xe-133. When the activity falls to about 70 mCi, a make up dose will be ordered from the radiopharmacy and added to the Ventil-Con II. The Ventil-Con II is shielded with 5/16" lead on the arm, 1/8" lead on the spirometer, and 1/4" lead on the trap. When the instrument contains 100 mCi of Xe-133, the exposure rate at the surface will be less than 1 mR/hour. Page 8 shows the floor plan of the complete Nuclear Medicine wing. The rooms where Xe-133 will be used or stored are rooms B, H, and J, which are shown in detail on page 9. These rooms all have floor level xenon exhaust vents which discharge through a chimney at the end of the wing. The chimney is 35 feet tall and 10 feet above the roof of the wing. The nearest window to the chimney is at the end of the wing on the second floor, about 15 feet below the chimney. The nearest air intake for the building ventilation is between the rooms labeled C and D on page 8 and 10 feet off the ground (25 feet below the chimney). The Ventil-Con II is stored in the isotope preparation lab (room J). The air flow rates are shown on page 9. There is no change in these rates between winter and summer. There is negligible air from rooms B, H, and J recirculated to the wing or other areas of the hospital. There are three exhaust vents on page 9 showing 0 CFM. These are return vents to the building circulation, and are blocked so that no air from these three rooms is recirculated. There are four exhaust vents marked with an asterisk. These are floor level xenon exhaust vents which discharge through the chimney. The xenon exhaust fans are left on continuously and there is a warning light on the switch which indicates if the fans are on or off.

All the ventillation rates in rooms B, H, and J will be measured semi-annually including the blocked vents. The instrument used will be an ALNOR Thermo-anemometer, type 8500, serial no. 4351, or equivalent. The results will be reviewed by the radiation Safety officer and kept on file.

C. Procedures for Routine Use

The Ventil-Con II is a rebreathing system. The patient breaths in from the internal atmosphere of the machine by normal tidal breathing. The patient's exhaled breath is filtered for bacteria, passed through a CO_2 absorber, a moisture absorber, and returned to the internal atmosphere of the machine. The volume lost by CO_2 absorption is made up by O_2 which is automatically injected into the internal atmosphere. During rebreathing, all Xe-133 is returned to the internal atmosphere of the machine. The system is switched over from rebreathing to wash-out at the end of an exhalation to minimize the amount of Xe-133 taken away from the internal atmosphere of the machine. During wash-out the patient breathes in room air and exhales through an interface and a xenon trap. The interface controls the rate at which exhaled breath is passed through the trap to 5 liter/min.

The discharge from the trap is continuously monitored by an end window G-M tube which activates an audio visual alarm when the concentration in the exhaust port exceeds 1×10^{-2} micro-Ci/ml. The proper functioning of the monitor will be verified weekly by placing a standard Cs-137 source at a fixed distance from the G-M tube. A log of these checks will be kept with the Ventil-Con II. The xenon trap filters will be changed whenever the concentration in the exhaust port reaches 1×10^{-2} uCi/ml which is the level at which the alarm is triggered. The cap from the new filter will be used to cap the old filter and the old filter will be held for decay in the decay area (see location x on pages 8 and 9). The old filter will be decayed for at least 10 half lives (53 days). During decay, the filter will be kept within a box with 1/4 inch lead shielding. Every 50 patients, the CO_2 absorber will be changed and a log of these changes will be kept with the Ventil-Con II.

Careful instruction (in simple, explicit language) is given to the patient participating in studies using radioactive Xenon-133. Nose clamps are employed to reduce leakage.

D. Emergency Procedures

The room volumes, air exchange rates, and times for one complete air exchange are shown below.

Room	Room Volume	Air Exchange Rate	time for one room volume exchange
Isotope prep. (J)	2500 ft^3	200 CFM	12 min.
Picker Room (H)	3490 ft^3	300 CFM	12 min.
GE/Elscint Room (B)	7480 ft^3	600 CFM	13 min.

In the event that a full 100 mCi were accidentally vented, the following airborne concentrations are predicted (assuming complete mixing).

Room	Concentration
Isotope Prep. (J)	$\frac{10^5 \text{ uCi}}{7.08 \times 10^7 \text{ ml}} = 1.4 \times 10^{-3}$ uCi/ml
Picker Room (H)	$\frac{10^5 \text{ uCi}}{9.88 \times 10^7 \text{ ml}} = 1.0 \times 10^{-3}$ uCi/ml
GE/Elscint Room (B)	$\frac{10^5 \text{ uCi}}{2.12 \times 10^8 \text{ ml}} = 4.7 \times 10^{-4}$ uCi/ml

In the event of a significant spill the following steps will be taken:

1. All persons will be evacuated from the room as rapidly as possible.
2. The door to the room will be closed and attended to make sure it is not opened.
3. The RSO will be notified by telephone.
4. The RSO may ask non-essential people to leave the wing at his discretion.
5. The room will not be entered for at least 25 minutes.
6. A radiation survey will be performed at floor level before re-entry to the room.

E. Air Concentrations of Xe-133 in Restricted Areas

1. The weekly amount of xenon brought into the lab is assumed to be 200 mCi.

2. We assume the fraction lost to be 0.1 in the Picker Camera Room, 0.1 in the GE/Elscint Camera Room, and 0.1 in the isotope preparation lab.

3. The average air concentration of Xenon-133 in the Picker Camera Room is expected to be AxF/V.

$$= \frac{200 \text{ mCi} \times .1}{300 \text{ ft}^3/\text{min}} \times \frac{1 \text{ ft}^3/\text{min}}{6.8 \times 10^7 \text{ ml}/40 \text{ hr wk}}$$

$$= 9.8 \times 10^{-10} \text{ mCi/ml}$$

$$= 9.8 \times 10^{-7} \text{ uCi/ml}$$

4. The average air concentration of Xenon-133 in the GE/Elscint Camera room is expected to be AxF/V.

$$= \frac{200 \text{ mCi} \times .1}{600 \text{ ft}^3/\text{min}} \times \frac{1 \text{ ft}^3/\text{min}}{6.8 \times 10^7 \text{ ml}/40 \text{ hr wk}}$$

$$= 4.9 \times 10^{-10} \text{ mCi/ml}$$

$$= 4.9 \times 10^{-7} \text{ uCi/ml}$$

5. The average air concentration of Xenon-133 in the isotope preparation lab is calculated from the fraction lost per week, plus the amount escaping from stored traps per week. If the amount stored in traps is T, and the fraction of the trapped xenon that escapes per week is F', then the average air concentration is given by

$$\frac{(A \times F) + (T \times F')}{V}$$

The appendix on page 7 shows the maximum amount of xenon stored in traps to be T=250 mCi. We assume the fraction of the trapped xenon escaping per week to be F' = 0.1. The average air concentration is then

$$\frac{(200 \text{ mCi} \times .1) + (250 \text{ mCi} \times .1)}{200 \text{ ft}^3/\text{min}} \times \frac{1 \text{ ft}^3/\text{min}}{6.8 \times 10^7 \text{ ml}/40 \text{ hr wk}}$$

$$= 3.3 \times 10^{-9} \text{ mCi/ml}$$

$$= 3.3 \times 10^{-6} \text{ uCi/ml}$$

F. <u>Air Concentrations of Xe-133 in Unrestricted Areas</u>

As described in section B, there is negligible recirculation of air, and the xenon released to unrestricted areas will be through the chimney at the end of the wing. Note that earlier we assumed that a fraction of 0.1 was lost in the isotope preparation lab, and another fraction of 0.1 in each of the camera rooms, B and H. This was necessary because we are not sure at this time if one of the two camera rooms will be used for most of the studies or if the work will be equally distributed. We feel, however, that 0.2 is a conservative estimate for the total fraction of xenon lost from all three rooms.

Amount discharged through chimney due to loss during storage and administration:

200 mCi/wk x 0.2 = 40 mCi/wk

Amount discharged through chimney due to leakage from traps:

250 mCi x 0.1/wk = 25 mCi/wk

Total = 65 mCi/wk x 52 wk/yr x 10^3 uCi/mCi = 3.4×10^6 uCi/yr

The dilution volume is based on the total CFM from the four floor level xenon exhaust vents in rooms B, H, and J.

$$\text{Dilution volume} = \frac{1100\ \text{ft}^3}{\text{Min}} \times \frac{1.49 \times 10^{10}\ \text{uCi/yr}}{\text{ft}^3/\text{min}} = 1.64 \times 10^{13}\ \text{ml/yr}$$

Finally the average concentration released to unrestricted areas =

$$\frac{3.4 \times 10^6\ \text{uCi/yr}}{1.64 \times 10^{13}\ \text{ml/yr}} = 2.1 \times 10^{-7}\ \text{uCi/ml}$$

This is below the level set by 10 CFR 20.106

G. Additional Information

The ventillation rates shown on page 9 are not measured, but specified. The wing is an area of newly comp.eted construction and will not be accepted until the specified ventillation rates are met. Supply vents will be damped if necessary such that specified rates are not exceeded. Exhaust fans will be changed for larger sizes, if necessary such specified rates will be met or exceeded.

In order to further reduce the air concentration in both restricted and unrestricted areas, a hood has been ordered for installation in the isotope preparation lab. This hood will share the ducting with the floor level xenon vent in the isotope preparation lab, and will discharge through the chimney at the end of the wing. This will reduce the average concentration in the isotope preparation lab which was the highest of the three rooms. The increased volume through the chimney will also reduce the average concentration released to unrestricted areas. We feel that this additional will make exposure rates in restricted and unrestricted areas "as low as reasonably achievable".

APPENDIX

Amount of Xenon in traps stored for decay

1) We assume that a trap is used for a total of 28 studies: 7 studies per week for 4 weeks.

2) We also assume that each study delivers 20 mCi to the trap.

3) The amount of activity in the trap when it is removed for decay will be ($T_{1/2}$ = 5.3 days):

   a) week 1, 140 mCi deposited, decay 3 weeks = 9 mCi

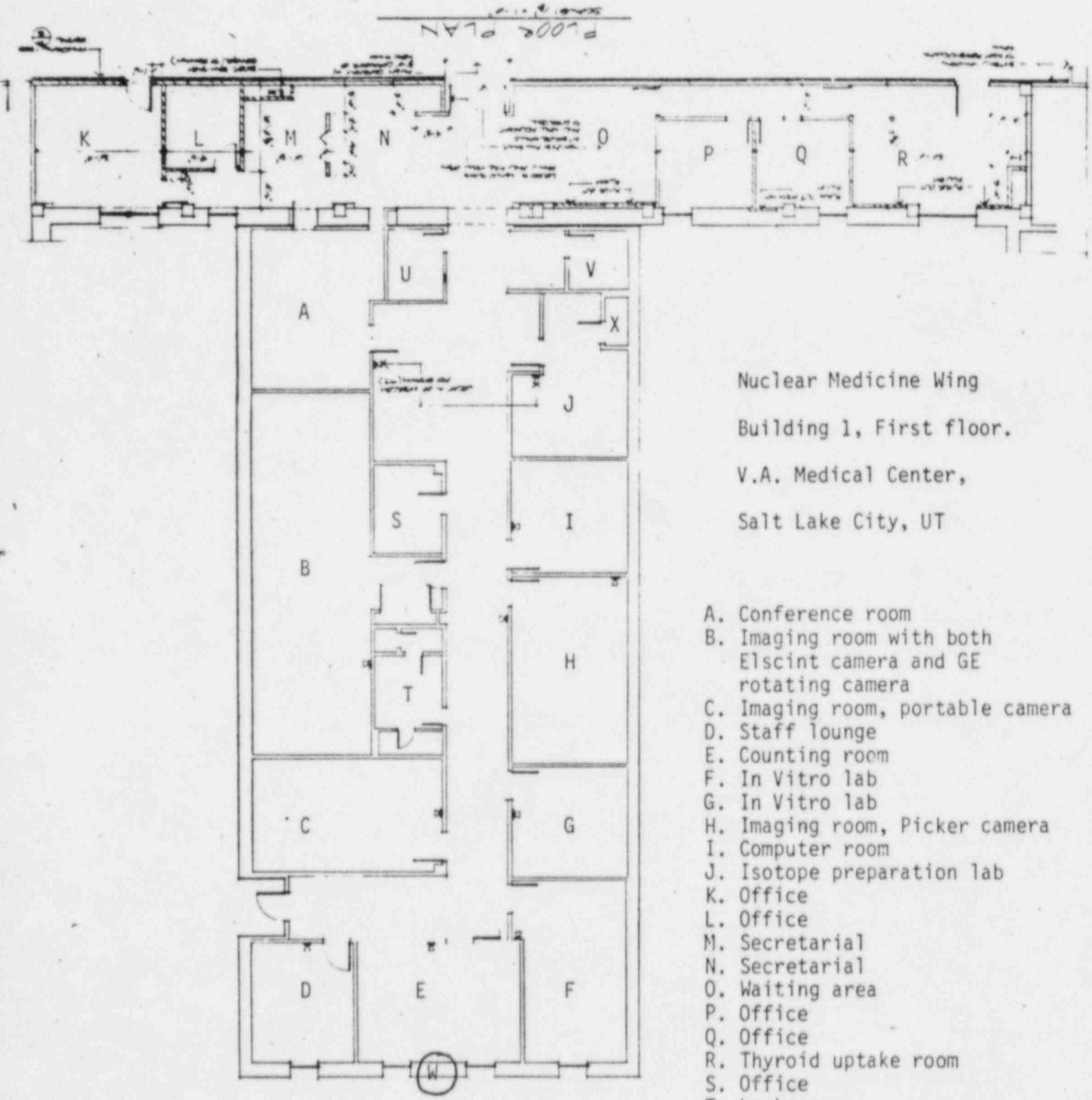
   b) week 2, 140 mCi deposited, decayed 2 weeks = 22 mCi

   c) week 3, 140 mCi deposited, decayed 1 week = 56 mCi

   d) Week 4, 140 mCi deposited, no decay = 140 mCi

   e) Total activity in the trap when removed for storage = 227 mCi

4) We assume that there are two traps stored in the decay area (x). The maximum amount of activity in the stored traps occurs when a trap is newly removed from the delivery system for storage. As shown above, the newly removed trap would contain about 230 mCi. The second trap would have been in storage about 28 days and would contain about 6 mCi. The maximum amount of activity stored in traps, would thus be less than 250 mCi.



Nuclear Medicine Wing

Building 1, First floor.

V.A. Medical Center,

Salt Lake City, UT

A. Conference room
B. Imaging room with both Elscint camera and GE rotating camera
C. Imaging room, portable camera
D. Staff lounge
E. Counting room
F. In Vitro lab
G. In Vitro lab
H. Imaging room, Picker camera
I. Computer room
J. Isotope preparation lab
K. Office
L. Office
M. Secretarial
N. Secretarial
O. Waiting area
P. Office
Q. Office
R. Thyroid uptake room
S. Office
T. Lockers
U. Film processor
V. Toilet
W. Chimney
X. Decay area

AREAS OF NUCLEAR MEDICINE WING WHERE XENON-133 WILL STORED OR USED