Mercy Hospital
Medical Center Sixth & University • Des Moines, Iowa 50314
Phone 515/247-3121

July 10, 1985

U. S. Nuclear Regulatory Commission
Radioisotopes Licensing Section
Region III
Roosevelt Road
Glen Ellyn, Illinois 60137

Re: Amendment to our NRC Radioactive Materials License #14-01137-01

Gentlemen:

We request an amendment to our NRC Radioactive Materials License #14-01137-01 for the following:

Add: Additional Nuclear Medicine Imaging room as per attached sketch.

Delete: Alternate Nuclear Medicine Area. We confirm a "close-out radiation survey" will be performed before that area is released for unrestricted use. Records of this survey will be maintained at our hospital for NRC inspection. Action levels will be 0.05 mr/hr as measured with a low level G.M. Survey meter and 200 DPM/100cm , as measured with a well counter. The NRC "Guide for Decontamination of Facilities" dated July, 1982 will be followed.

Enclosed is the revised Xenon application to incorporate the new Nuclear Medicine imaging room with the Nuclear Medicine Department.

We trust the information contained herein is sufficient to grant our request for this amendment. We look forward to receipt of that document.

Sincerely,

K. David Lane V.P.

for Sister Patricia Clare Sullivan, RSM
President

:amw

Mercy Hospital Medical Center
Sixth and University Avenues
Des Moines, Iowa 50314

Supporting Documentation for Use of Xe-133

Date: July 3, 1985

In support of our request to use Xe-133 for lung ventilation procedures, we submit the following information as outlined in Appendix M, "Procedures and Precautions for Use of Radioactive Gases", of Regulatory Guide 10.8.

1. Quantities to be used:

   a. (1) We anticipate the maximum annual number of Xe-133 patient studies to be 250 for an average weekly total of 5 patients.

   (2) At 20 mCi/patient, our average weekly utilization of Xe-133 would be 100 mCi.

   b. We request a possession limit of 600 mCi to provide for Xe-133 decaying in storage and for shipments whose calibration dates are several days after receipt.

2. Use and Storage Areas

   a. Attached is a facility sketch showing the areas in which we plan to use and store the Xe-133. Vent locations and planned air flow rates are shown on the sketch. Xe-133 shipments will be stored in the lead shielded hot lab area.

   b. Air flow rates of the vents will be as follows:

   (1) Fraction of air recirculated into other areas of the facility = 0%.

   (2) Exhaust: At least 3150 cfm. This exhaust is direct to the outside and is at least 20 feet distant from the nearest hospital intake duct. No blocking objects will be placed in front of the exhaust vents.

   c. We confirm that total supply vent air in this location will be kept at least 10% below the total exhaust vent rates to ensure a negative pressure effect.

3. Procedures for routine use:

   a. The Medi+Physics dispensing system or other NRC licensed system will be used to inject precalibrated single dose Xe-133 into the Xe-133 delivery unit.

b. We plan to use a Victoreen Xenogard air trap monitor Model 36-751 gas trap system or similar NRC approved Xe-133 system for these procedures. (Descriptions attached.)

c. Entrance doors to the nuclear medicine area will be closed during any use of Xe-133 gas. Since camera room and hot lab are in the same room, there are no separate ventilation specifications or calculations for the hot lab.

4. Emergency Procedures

In the event of an accidental release of Xe-133 into the room, we will temporarily evacuate the room(s) and reclose the entrance door for a period of 19.264 minutes (five room air exchanges). With a total exhaust rate of at least 3150 cfm and a total room volume of approximately 12136.5 cubic feet, we estimate one room air turnover to be a maximum of 3.852 minutes.

We confirm that a low level survey meter will be used to survey the affected area to confirm normal background readings prior to permitting reoccupation of the room.

5. Xe-133 Concentrations in Restricted Areas:

20.103 of 10 CFR 20 requires that Xe-133 concentrations, averaged over a 40 hour week for a calendar quarter do not exceed 1 x E-5 uCi.

a. The estimated weekly utilization (A) of Xe-133 in our facilities will be 100 mCi (see Item 1,a,(2) of this application).

b. The estimated fraction of Xe-133 lost (f) during these procedures and during storage is 0.20 (or 20%).

c. The minimum amount of air flow (V) necessary per week to dilute the Xe-133 to less than 1 x E-5 uCi/ml is calculated as follows:

$$A/V \times f \leq 1 \times E\text{-}5 \text{ uCi/ml}$$

or

$$V \geq \frac{A \times f}{1 \times E\text{-}5 \text{ uCi/ml}}$$

$$V \geq \frac{100 \text{ mCi} \times 1000 \text{ uCi/mCi} \times .20}{1 \times E\text{-}5 \text{ uCi/ml}}$$

$$V \geq \frac{20 \times E4 \text{ uCi}}{1 \times E\text{-}5 \text{ uCi/ml}}$$

$$V \geq 20 \times E9 \text{ ml/week}$$

Since 1 cfm = 6.797 x E7 ml/40 hr week, this translates to a

required air flow rate of 29.424 cfm.

$$V \geq \frac{20 \times E9 \text{ ml/week}}{6.797 \times E7 \text{ ml/40 hr week/cfm}}$$

$$V \geq 29.424 \text{ cfm}$$

We confirm that the ventilation rate will be well over 29.424 cfm to maintain air concentrations of Xe-133 as low as reasonably achievable. These rates will be checked semi-annually to verify compliance with NRC limits.

6. Xe-133 Concentrations in Unrestricted Areas:

a. We will use a charcoal gas trap as our primary means of disposing of Xe-133. Since Xe-133 gas traps are not 100% efficient for trapping Xe-133, we use the following method to ensure that Xe-133 concentrations will not exceed the 10CFR 20.106 limit of 3 x E-7 uCi/ml, averaged over 1 year.

(1) As calculated in item 5,c., of this application, the estimated fraction of Xe-133 lost during use and storage is 20 x E4 uCi/week.

(2) This can be expressed in uCi/year as follows:

$$20 \times E4 \text{ uCi/week} \times 52 \text{ weeks/year} = 1040000 \text{ uCi/year}$$

(3) 10CFR 20.106 requires that $C = A/V \leq 3 \times E\text{-}7$ uCi/ml

The required ventilation rate (V) to maintain concentrations below this level is therefore:

$$V \geq \frac{A}{3 \times E\text{-}7 \text{ uCi/ml}}$$

$$V \geq \frac{1040000 \text{ uCi/year}}{3 \times E\text{-}7 \text{ uCi/ml}}$$

$$V \geq 3.466E+12$$

(4) This rate can then be translated to cfm as follows:

$$V \geq \frac{3.466E+12 \text{ ml/year}}{1.484 \times E10 \text{ ml/year/cfm}}$$

$$V \geq 233.602 \text{ cfm}$$

We confirm the ventilation rate will be greater than 233.602 cfm to maintain Xe-133 levels in unrestricted areas as low as

reasonably achievable. The air flow rates will be remeasured semi-annually to verify compliance with NRC limits.

b. To monitor our Xe-133 gas trap exhaust (to ensure trapping efficiency) we will use either a commercially available trap monitor (such as a Rad-X Model 120) (brochure for Atomic Products equipment is attached) or will collect Xe-133 gas trap exhaust in a plastic bag and assay the Xe-133 content with our gamma camera.

If we obtain a trap monitor, we confirm we will follow the manufacturer's instructions for use and calibration frequency of the instrument (at least annually).

The bag method will involve:

(1) Determining camera detection efficiency using a known source of Tc99m, Co-57, Xe-133, or other low energy radionuclide. Configuration of the source will be in the form of a flood phantom rather than a point source to approximate the geometry of the bag.

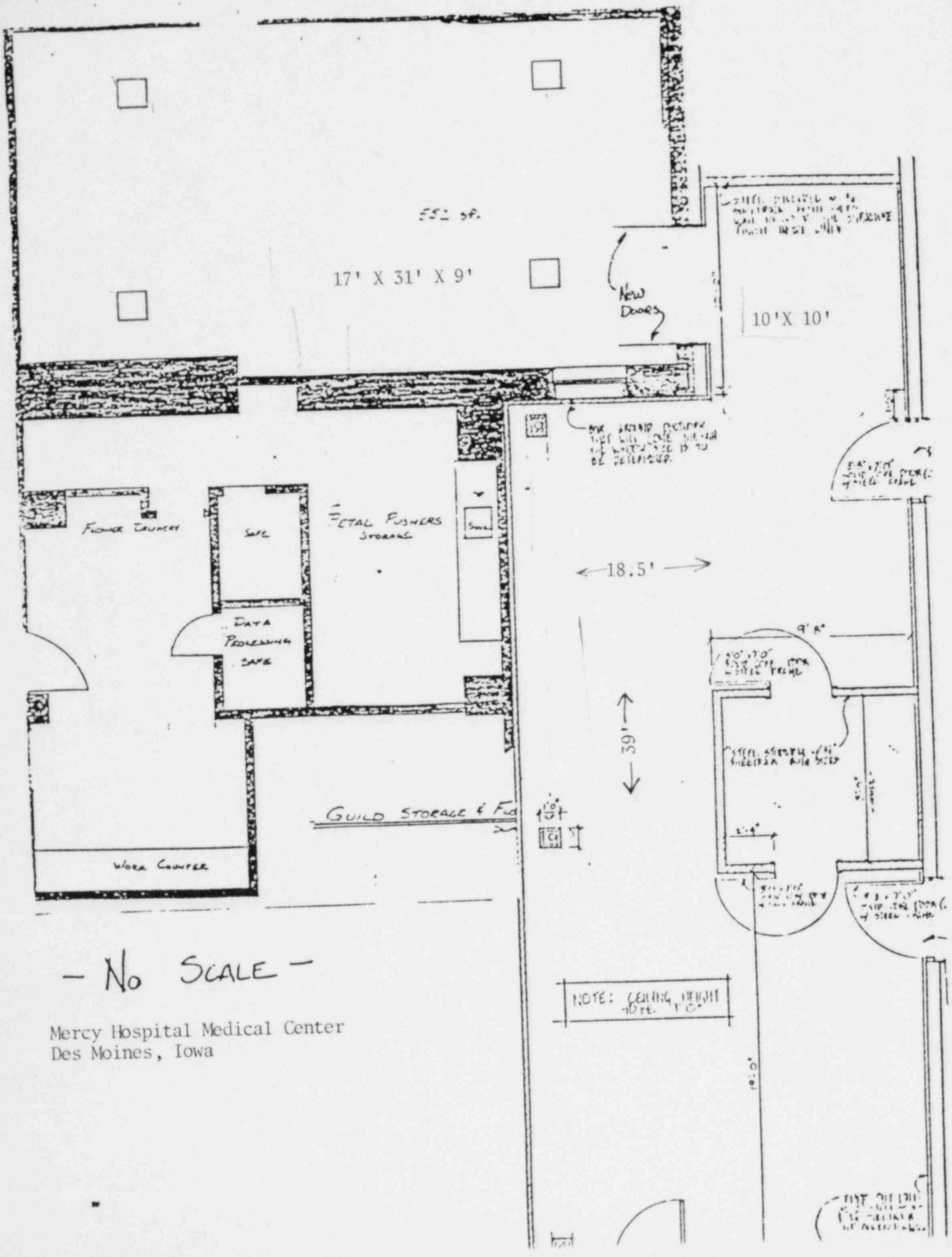
(2) Assaying a Xe-133 exhaust bag and calculating the quantity (act vity) of Xe-133 leakage. The frequency of this check will be initially and at least monthly, or more frequently, if more than 30 Xe-133 studies are performed in a given month.

(3) Calculating whether or not the trap is at least 95% efficient by dividing trap leakage by administered activity.

(4) Manufacturers specify that charcoal traps are at least 98% efficient for trapping Xe-133. Therefore, we feel that 95% is a reasonable action level at which point the charcoal filters would need replacement.

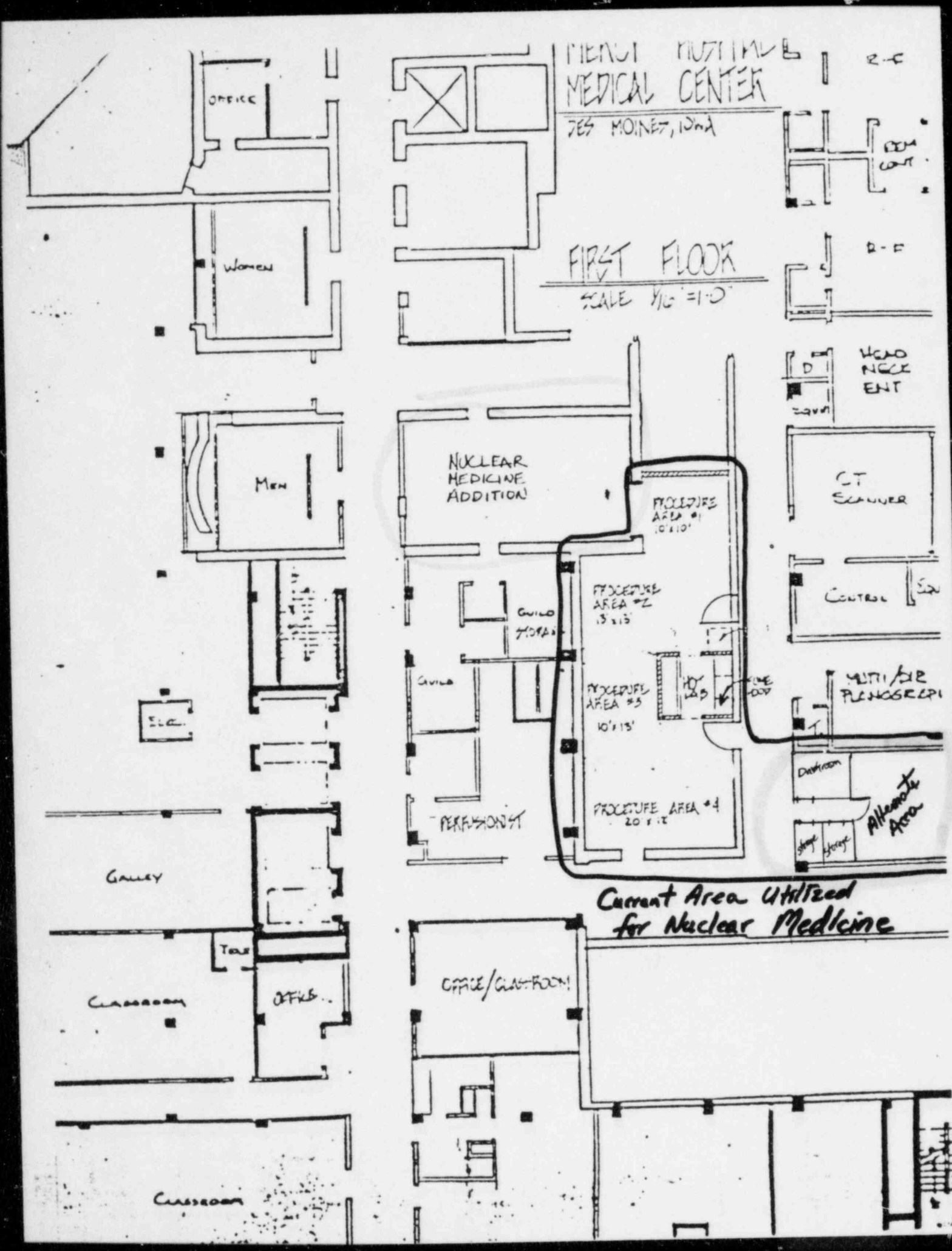
(5) The saturated filter will be removed and the portals will be tightly capped with rubber stoppers. In this manner, the cartridge will not leak since air is not flowing through the unit. The surface readings of the lead shielded "saturated" cartridge should not exceed normal background levels, as determined with a low level survey meter, or additional lead foil (1/8" thick) will be wrapped around the cartridge until this background reading is achieved. The unit will be stored in the hot lab storage area and allowed to decay. The attached sketches, descriptions of shielding, and previously defined calculations of average concentrations in air should serve to also cover this final phase of Xe-133 handling procedures.

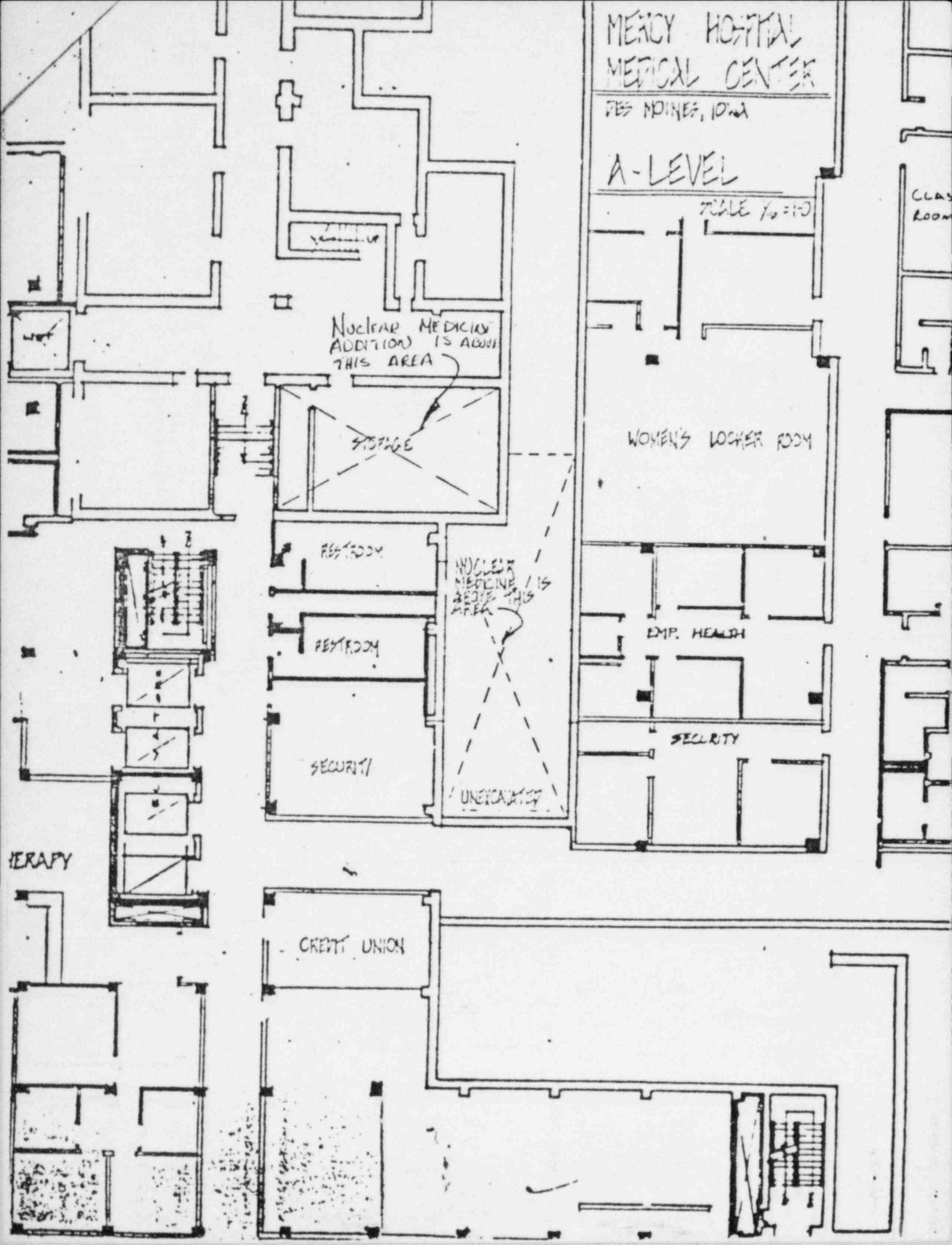
We also confirm that all disposal items are to be surveyed with a low level g.m. survey meter to confirm exposure rates of normal background (less than 0.05 mr/hr) prior to disposal.

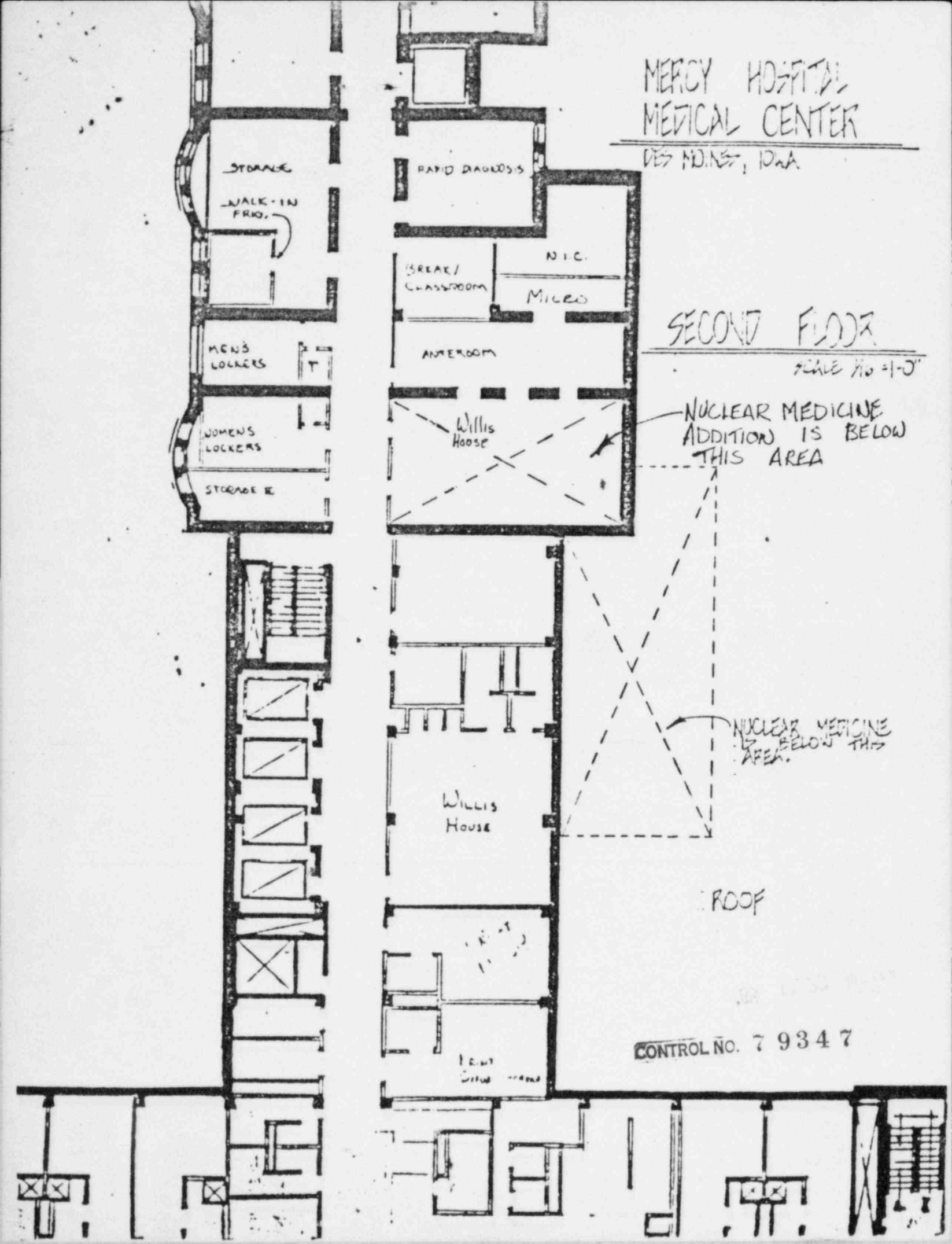


- No SCALE -

Mercy Hospital Medical Center
Des Moines, Iowa


MERCY METHODIST
MEDICAL CENTER
DES MOINES, IOWA
FIRST FLOOR
SCALE 1/16" = 1'-0"
OFFICE
WOMEN
MEN
ELEC.
GALLEY
TOILET
CLASSROOM
OFFICE
CLASSROOM
NUCLEAR MEDICINE ADDITION
PROCEDURE AREA #1 10'x10'
PROCEDURE AREA #2 15'x15'
PROCEDURE AREA #3 10'x15'
PROCEDURE AREA #4 20'x12'
GUILD STORAGE
GUILD
PERFUSIONIST
HOT LAB
CLEAN UTIL
DARKROOM
Alternate Area
OFFICE/CLASSROOM
D
HEAD NECK ENT
CT SCANNER
CONTROL
MULTI/SR PLANOGRAPH
Current Area Utilized for Nuclear Medicine


MERCY HOSPITAL
MEDICAL CENTER
DES MOINES, IOWA
A-LEVEL
SCALE 1/8"=1'-0"
NUCLEAR MEDICINE ADDITION IS ABOVE THIS AREA
STORAGE
WOMEN'S LOCKER ROOM
RESTROOM
RESTROOM
NUCLEAR MEDICINE IS BELOW THIS AREA
SECURITY
UNEXCAVATED
EMP. HEALTH
SECURITY
CREDIT UNION


MERCY HOSPITAL
MEDICAL CENTER
DES MOINES, IOWA
STORAGE
WALK-IN FRIG.
RADIO DIAGNOSIS
N.I.C.
BREAK/ CLASSROOM
MICRO
MENS LOCKERS
ANTEROOM
WOMENS LOCKERS
STORAGE
Willis House
SECOND FLOOR
SCALE 1/10 = 1-0"
NUCLEAR MEDICINE ADDITION IS BELOW THIS AREA
NUCLEAR MEDICINE IS BELOW THIS AREA.
Willis House
ROOF
CONTROL NO. 7 9347