freeman hospital

417/623-2801 1102 W. 32ND JOPLIN, MISSOURI 64801

Richard E. Long, Administrator

November 19, 1985

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

Re: Amendment to our NRC Radioactive Materials License #24-17205-01

Gentlemen:

We request amendment to our NRC Radioactive Materials License #24-17205-01 for the following:

CHANGE IN LOCATION OF NUCLEAR MEDICINE DEPARTMENT: Enclosed please find a facility sketch representing the design of our new Nuclear Medicine Department.

As soon as the license amendment is approved, we confirm that a "close-out" radiation survey of the current nuclear medicine room will be performed and the results will be retained in our files for inspection purposes. Action levels will be <0.05 mr/hr as measured with a low level G.M. Survey meter and 200 DPM/100cm^2, as measured with a well counter. The NRC "Guide for Decontamination of Facilities" dated July 1982 will be followed.

Enclosed is a revised Xenon-133 application for the new nuclear medicine rooms.

We hope this information is sufficient to grant our request for amendment. Enclosed is our check for $120 to cover amendment processing fee.

Sincerely,

Richard E. Long
Administrator

:amw

Applicant Dec 2 - III
Check No. 43987
Amount Fee Category 7C $120
Type Fee Amend
Date Check Rec'd 12/2/85
Received By [illegible]

Freeman Hospital
1102 West 32nd Street
Joplin, Missouri 64801

Supporting Documentation for Use of Xe-133

Date: November 19, 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 300 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 1165 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 NEN's "CALIDOSE" dispensing system or other NRC licensed system will be used to inject precalibrated single dose Xe-133 into the Xe-133 delivery unit. (Descriptions attached)

   b. We plan to use a gas trap system approved by the NRC for these procedures.

c. Entrance doors to the nuclear medicine area will be closed during any use of Xe-133 gas. Since the hot lab and camera room use the same exhaust, we will leave the doors open between these rooms.

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 18.714 minutes (five room air exchanges). With a total exhaust rate of at least 1165 cfm and a total room volume of approximately 4360.5 cubic feet, we estimate one room air turnover to be a maximum of 3.742 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.

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

$V \geq 29.424$ 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

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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 (activity) 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.

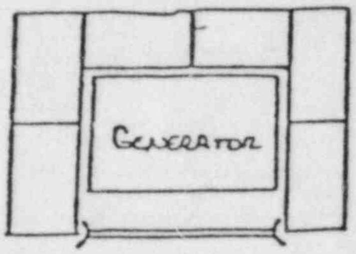
REF: NRC 313M - Item 11

FACILITIES AND EQUIPMENT

Shielding Around Generator:

The generator is shielded on the rear by a wall of standard size lead bricks (each 2" thick X 4" wide X 8" long). This wall is three (3) bricks (12") high and two (2) bricks (16") long. Immediately adjoining both sides of this rear wall are side walls of lead bricks of the same dimensions as the rear wall. The front of the generator area is shielded by an upright Protective Lead Barrier 15" high X 15" wide X 1/2" thick, to prevent direct exposure to personnel eluting the generator. The generator area location on the hot lab work bench is shown on the facility sketch. A top view of this arrangement is shown below.

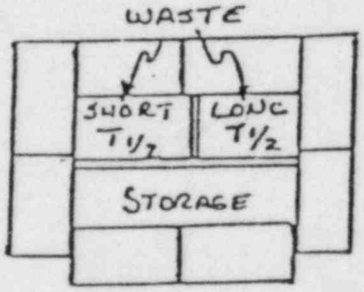
See (A) on attached sketch.



Storage and Waste Area Shielding:

The active storage/waste area is sheilded on all four (4) sides by standard size lead bricks as described above for the generator area shielding, except that a front lead brick wall is substituted for the protective lead barrier. This storage area is located on the hot lab area work bench as shown on the facility sketch. This lead brick storage area will be divided by plywood or similar material into three (3) compartments as shown on the diagram below. We do not anticipate the use of many long-lived radionuclides and the short-lived waste compartment contents can be more frequently surveyed for disposal to avoid waste accumulation or the need for any other radioactive storage or waste areas. A top view of the storage area shielding is shown below:

See (B) on attached sketch.

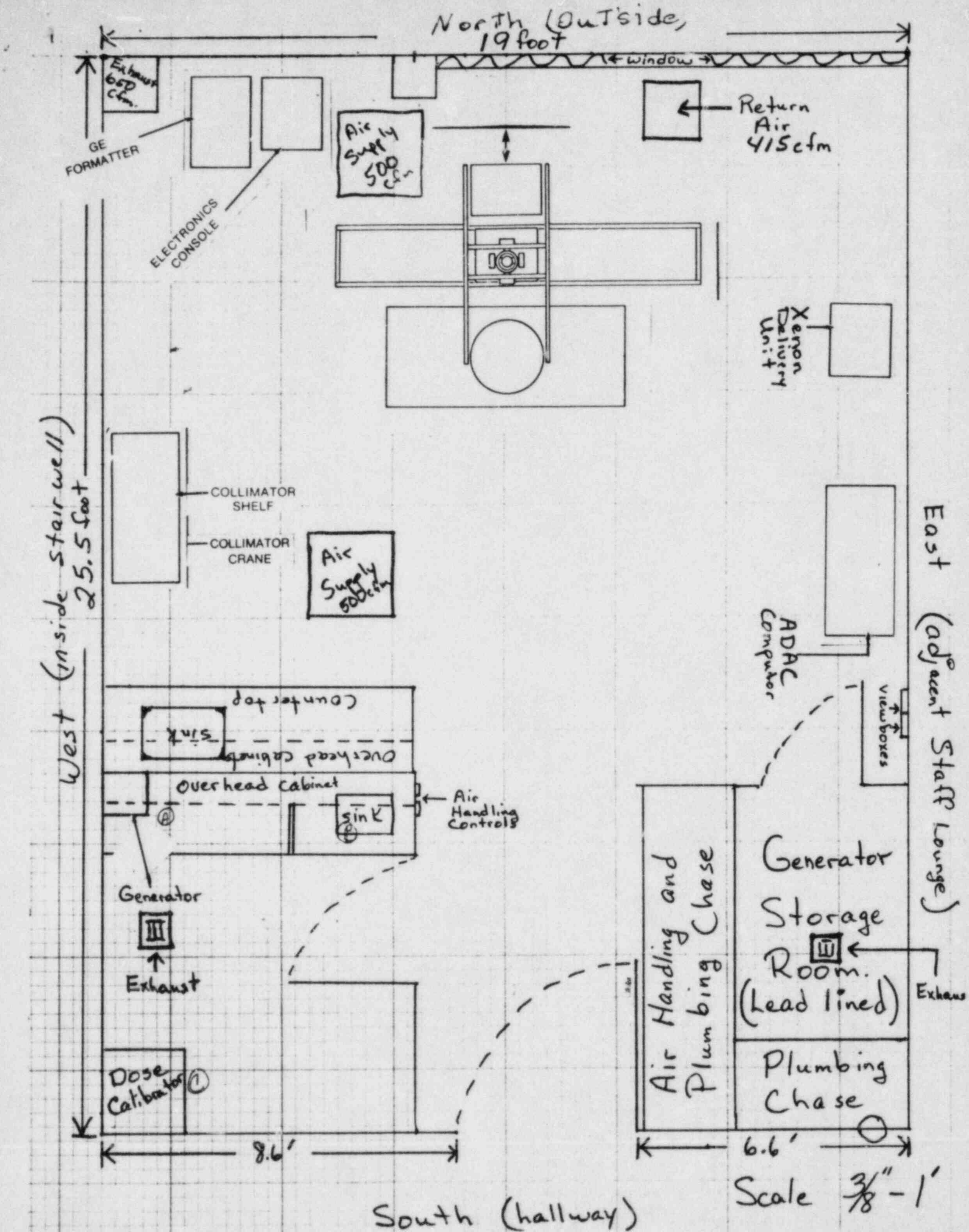


Dose Preparation Area:

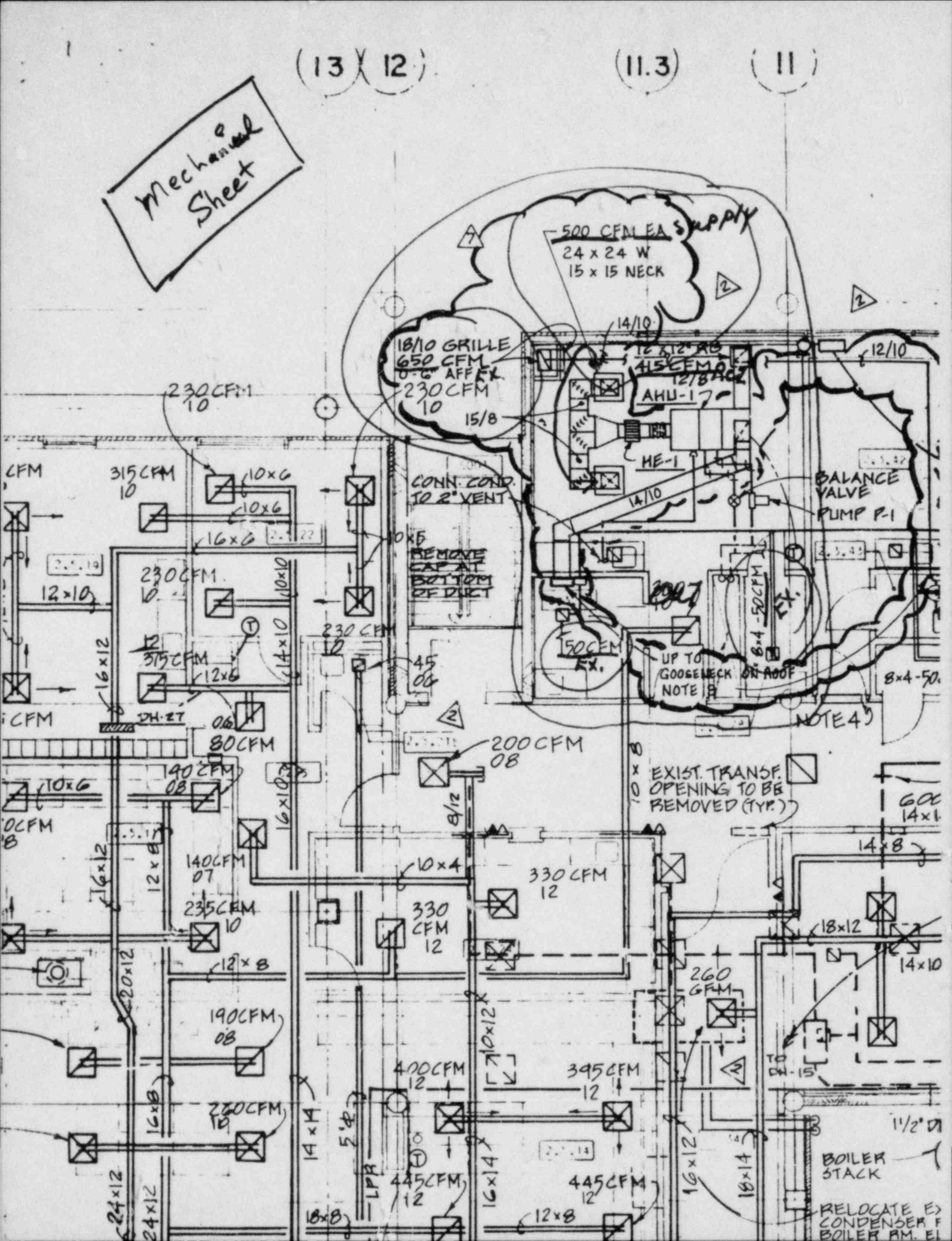
The dose preparation area on the hot lab area work bench as shown on the facility sketch, is shielded in the front by an upright Protective Lead Barrier (15" X 15" X 1/2" thick). Disposable gloves, remote handling tongs (4" to 8" long), survey meters, plastic backed absorbent pads and all other ancillary supplies mentioned in NRC Regulatory Guide 10.8, dated October 1980, will also be on hand in this hot lab area.

Equivalent shielding to maintain minimal exposure levels may be used.

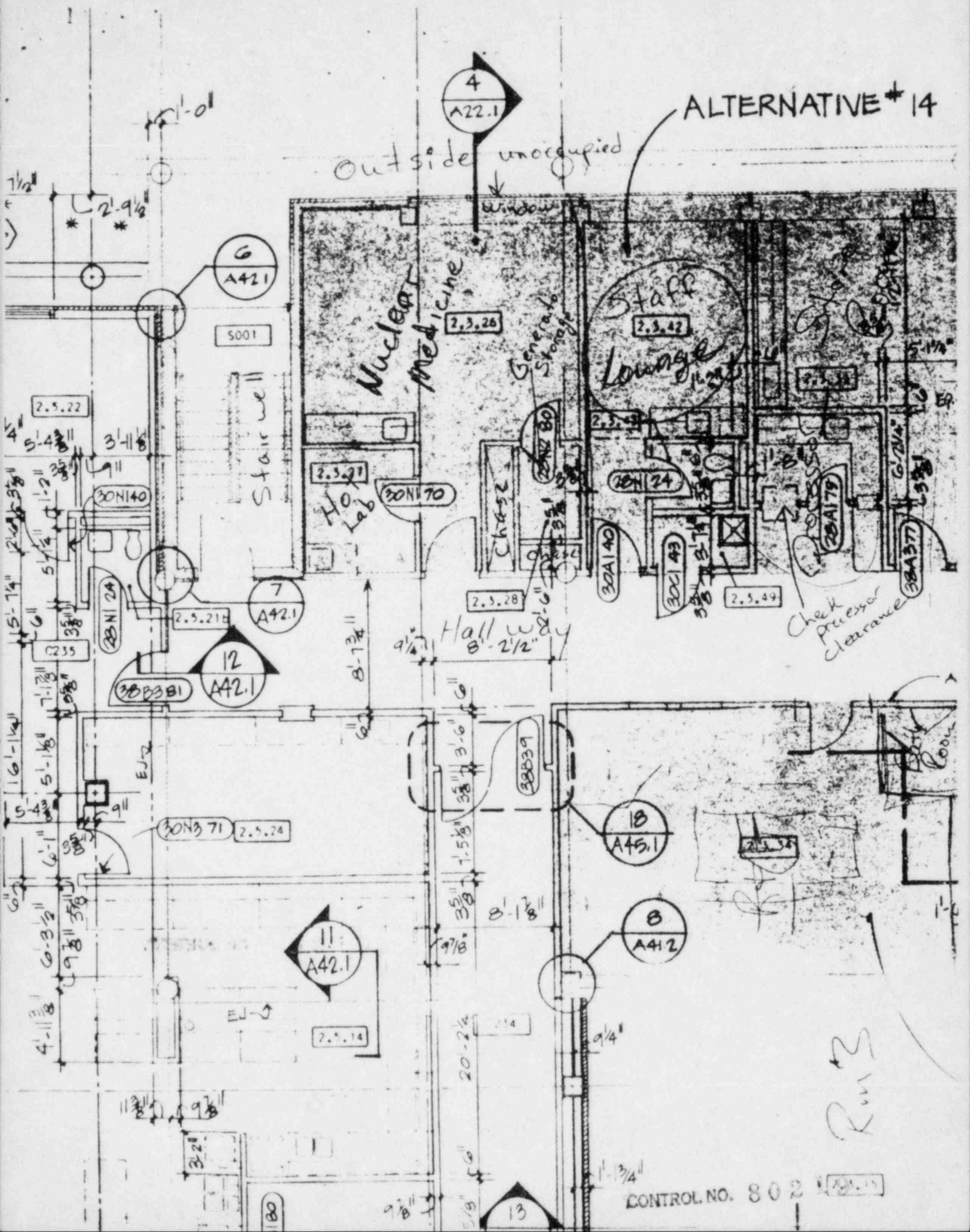
See (C) on attached sketch



CONTROL NO. 80219



13
12
11.3
11
Mechanical Sheet
500 CFM EA Supply
24 x 24 W
15 x 15 NECK
18/10 GRILLE
650 CFM
0'-6" AFF EX.
230 CFM
10
14/10
415 CFM
12/8
AHU-1
15/8
HE-1
12/10
BALANCE VALVE
PUMP P-1
CONN. COND. TO 2" VENT
REMOVE CAP AT BOTTOM OF DUCT
315 CFM
10x6
16x6
12x10
16x12
14x10
12x6
DH-27
80 CFM
190 CFM
08
10x6
140 CFM
07
235 CFM
12 x 8
20x12
190 CFM
08
16x8
280 CFM
24x12
200 CFM
08
EXIST. TRANSF. OPENING TO BE REMOVED (TYP.)
50 CFM EX.
UP TO GOOSENECK ON ROOF NOTE 8
NOTE 4
8x4-50 CFM EX.
330 CFM
12
10x4
10x12
14 x 14
400 CFM
12
395 CFM
12
445 CFM
12
18x8
12x8
16x14
16x12
18x14
260 CFM
14x8
18x12
14x10
TO DH-15
BOILER STACK
RELOCATE E
CONDENSER F
BOILER RM. E



ALTERNATIVE # 14
Outside unoccupied
window
Nuclear Medicine
2.3.26
Staff Lounge
2.3.42
Generator Storage
Stairwell
S001
2.5.22
Hot Lab
2.3.27
30N170
30N140
28N124
2.5.21
Chase
2.3.28
30A140
30C143
2.3.49
28A179
38A377
Check processor clearance
Hallway
8'-2 1/2"
C235
38B381
12
A42.1
7
A42.1
6
A421
4
A22.1
30N371
2.5.24
38B39
18
A45.1
8
A41.2
11
A42.1
2.5.14
EJ
13
Rm 3
CONTROL NO. 802