JACKSON COUNTY MEMORIAL HOSPITAL

1200 EAST PECAN ALTUS, OKLAHOMA 73521 405 482 4781

December 8, 1981

Director, Office of Nuclear
Materials Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Sir:

Please amend license number 35-19227-01 as follows:

1. To include I-131 as Iodide for treatment of hyperthyroidism and cardiac dysfunction. 30 mCi is the maximum requested possession limit.

2. To include I-131 as Iodide for treatment of thyroid carcinoma. 100 mCi is the maximum requested possession limit.

3. To include Xenon-133 gas for pulmonary function studies.

All of the nuclear activities of this license are under the direction of Earle Stine, Jr., M.D. He has been licensed for I-131 therapy as requested in items (1) and (2) above at St. Joseph Medical Center in Ponca City, Oklahoma, License #35-14046-02.

Appendix K of Regulatory Guide 10.8 will be followed for all patients hospitalized for radioisotope therapy. Training is given to all involved personnel according to 10CFR19.12 before beginning duties and during annual refresher courses. Each person involved in Group IV and or Group V radiopharmaceuticals requested above will be given additonal training prior to involvement.

Addendum 1 is applicable information regarding the use of Xenon-133.

David Turnbo,
Associate Administrator

Earle Stine, Jr. M.D.
Director of Nuclear Medicine

XENON-133 INFORMATION

II. General Information - 1

1. A maximum possession limit of 300 mCi from an estimated 100mCi per week maximum activity adjusted for four (4) days pre-calibration (100mCi x 1.7 precalibration factor) with a maximum of 40 mCi decaying gives a maximum inventory of 210 mCi.

2. An average patient dose of 10 mCi will be routinely used. Higher doses will be used only when professional medical judgement indicates the necessity.

3. A maximum of 10patients per week and 520 patients per year is estimated.

4. Xe-133 radiopharmaceuticals will be purchased from New England Nuclear Corporation, Atomlight Place, No. Billerica, Mass. 01862. Doses will be disposable single-doses, catalog number NRP-127 which is FDA approved. A package insert is enclosed on pages 9 & 10.

5. A Picker Dyna Camera 4 Scintillation camera with data storage micro-dot accessories will be used for imaging.

6. A lead lined pig will be used for Xe-133 storage (See Figure 1 on page 11).

7. All personnel working in the department will wear body film badges and TLD finger badges and comply with the radiation safety program.

8. A scale drawing of the department is shown as figure 2 on page 11. A Nuclear Associates Xenon Air Monitor Model # 36-751L which is sensitive to a scale of 1 x 10^{-5} uCi/ml is operated continuously to detected airborne activity. See page 16

9. Description of Procedure: The Xe-133 capsule will be assayed after carefully removing the plastic capsule from its shipping tube using adequate radiation protection techniques. The patient will be instructed on the details of the procedure with special emphasis on the areas where his cooperation is needed. Just prior to the study, one or more practice runs will be done before the Xenon-133 gas is used. 500 ml of medical grade oxygen will be placed in the collection bag through the CO_2 canister for each minute of anticipated breathing time. The vial holder containing the Xenon-133 gas will be taken to the imaging area where the lung ventilation procedure will be done. The vial holder will be attached to the New England Nuclear Corporation NRP-186 Calidose Dispenser as instructed in the package insert (brochure is on pages 12 & 13). The Xenon-133 gas will be administered to the patient after the Dispenser has been connected to the Nuclear Associates Xenon-133 Lung Function Unit: Catalog Number 36-2006 (See Page 14). Nose clamps will be used to prevent the patient from exhaling the Xenon-133 gas into the room. The lung ventilation procedure will be composed of the three standard phases of breathe and hold, equilibrium, and washout. These phases are accomplished as the technologist operates the ventilation study system valve.

II. General Information - Continued

The breathe and hold and equilibrium phases are done with the Xenon passing between the patients lungs and the rebreathing - collection bag. The washout phase is done by having the patient breathe in room air and exhale through the Nuclear Associates, Inc. Xenon gas trap # 36-023L, see brochure on page 15.

III. Storage Area During Storage

A. The Xenon-133 gas doses will be stored in its 1/8" thick lead shipping tube as recieved form New England Nuclear Corporation. That tube containing the Xe-133 gas will in turn be stored in an airtight container (figure 1) that is lined with 1/8" lead. That container is stored in the fume hood located in the hot lab (figure 2, page 11). The storage container contains activated charcoal in its lower compartment separated from the Xe shipping tube by a wire mesh shelf. When the airtight container is opened to remove a Xe vial, the activated charcoal will be monitored to determine if there has been a leakage of Xe-133 gas from the shipping tube.

New England Nuclear states there is no detectable leakage of Xe-133 gas from the sealed plastic tube by checking with a detection efficiency of 0.01% per day. This gives two independent air tight containments which are themselves stored in the fume hood with the window closed. The normal hospital air circulation through the nuclear medicine laboratory is turned off before the fume hood window is opened. The hood exhaust is turned on prior to opening the fume hood window and removing the Xenon from its storage container. The fume hood exhaust will remain on until after completion of the Xenon study. The total volume of the hot lab is 280 cubic feet and the hood exhaust operates with a minimum air flow volume of 400 cubic feet per minute at its face with the hood window raised one foot.

The maximum concentration from leakage during the storage phase will be on Monday when the maximum activity is present. The maximum leakage is:

1. Maximum activity is 300 mCi = 3×10^5 uCi.

2. Maximum leakage is 0.01% which gives a maximum leakage rate of 30 uCi/day.

3. Room volume = $280\ ft^3 \times 2.832 \times 10^4 ml/ft^3 = 7.93 \times 10^6 ml$

4. The maximum concentration of Xenon in the hot lab during routine storage is $30/7.93 \times 10^6 = 3.78 \times 10^{-6}$ uCi/ml

5. Note that Monday is the worst situation since the Xenon decays faster (12%/day) than leakage occurs (0.01%/day). This verifies that the MPC of 1×10^{-5} uCi/ml as required for occupational exposures.

. Storage Area During Accidental Release

In the event of an accidental release of Xenon-133 in this area, the following procedure will be implemented. All personnel will leave the room and close the door. The room will remain unoccupied for 3.5 minutes.

The 3.5 minute period will insure 10 changes of the room air based upon the following calculations.

Air flow volume = 400 cubic feet per minute
Volume of room = 280 cubic feet.

$$\frac{\text{Room volume}}{\text{Air flow per minute}} = \text{Turn over time} = \frac{280 \text{ cu. feet}}{400 \text{ cu. ft/minute}}$$

Turn over time = 0.7 minutes
Turn over halftime = 0.35 minutes
Ten exchanges of room air would require 7.0 minutes. This is an extremely conservative estimate as shown below.

The air exhausted from this room is released directly into an unrestricted area located on the side of the hospital. The exhausted air is released 10 feet above the ground level into an unoccupied parking area. The release point is isolated from all air intakes by distances exceeding 75 feet and windows are never opened.

Another analysis of an accidental release in the hot lab is to assume a maximum 300 mCi was released in the 280 ft^3 volume. This solution assumes normal diffusion in the air for an original concentration of 300×10^3 uCi/280 $ft^3 \times 2.832 \times 10^4$ ml/ft^3 = 3.78×10^{-2} uCi/ml. Where:

$C = C_o e^{-\lambda t}$
C = Air concentration after 3.5 minutes.
C_o = Original air concentration at time of accidental release.
λ = 0.693/turn over halftime = 0.693/0.35
t = 7.0 minutes

Solution:

$$C = 3.78 \times 10^{-2} \, e^{-0.693(7.0/0.35)}$$

$$C = \underline{3.6 \times 10^{-8} \text{uCi/ml}}$$

V. Imaging Area During Routine Operation

All Xenon-133 lung ventilation procedures will be performed in the imaging room as shown on figure 2 on page 10. The hospital recirculation system will be turned off prior to removing the Xe from its storage area and will not be turned on until 30 minutes after all Xenon has been exhausted out the stack. Air will enter this room through the door. The air will leave the room via an exhaust system which has a minimum air flow of 400 cu. ft./minute. Since the inlet air into the imaging area has been turned off, a negative pressure is assured in the room during all Xenon activities. The following information will be used to calculate the maximum concentration of Xenon-133 for this restricted area during imaging.

1. Maximum amount of Xenon-133 is 10 mCi = 10^4uCi/ study.

2. Estimated escape fraction (maximum Xenon-133 activity lost due to leakage and inadvertent release) is 0.25 although Xenon is routinely "washed out" through the Nuclear Associates gas trap which has a 99% Xenon removal efficiency according to the manufacturer. (See Page 15)

3. The minimum air flow will be 400 cubic feet per minute. (Actual air exhausted to unrestricted area outside during patient exams.)

4. The room volume = 2800 cubic feet

5. Air exhaust halftime = $\frac{2800_X\ 0.5\ \text{min.}}{400}$ = 3.5 minutes

Therefore, using the above values and appropriate conversion factors, C can be calculated using the equation $C = C_o e^{-\lambda t}$. Since 30 minutes exhausting is continued after each imaging procedure, the remaining air will be:

C = Concentration after 30 minutes
λ = 0.693/air exhaust halftime = 0.693/3.5 minutes
C_o = Maximum concievable concentration

$$C_o = \frac{1.0 \times 10^4 \text{uCi} \times .25}{2800\text{ft}^2 \times 2.832 \times 10^4 \text{ml/ft}^3} = 3.15 \times 10^{-5} \text{uCi/ml}$$

$$C = 3.15 \times 10^{-5}\ \text{uCi/ml} \times e^{-0.693 \times 30/3.5}$$

$$C = 8.3 \times 10^{-8}\ \text{uCi/ml}$$

This verifies that the MPC of 1×10^{-5} uCi/ml as stated in 10CFR.20.106

VI. Imaging Area During Accidental Release

In the event there is an accidental release of Xenon-133 in the imaging room, the following emergency procedure will be implemented.

1. The patient will be removed form the room.

2. The exhaust will be turned to "high", which has a flow rate of at least 800 cubic feet per minute.

3. The department will remain closed for 18 minutes. Upon re-entry, the radiation level will be checked to assure the Xenon is gone.

The 18 minutes will ensure about 10 changes of the air in the the imaging room based on the following calculation.

Total air flow volume = 800 cubic feet per minute

The imaging room is 2800 cubic feet

The maximum activity released would be one capsule = 10mCi

Therefore:

$$\frac{\text{Volume X 0.5}}{\text{Air flow/minute}} = \text{Turnover halftime} = \frac{0.5 \text{ X } 2800}{800} = 1.75 \text{ minutes}$$

10 changes of the air in this room would require 18 minutes.

This is an extremely conservative estimate since the original air concentration would be (10 mCi X 10^3 uCi/mCi)/(2800ft^3 X 2.832 X 10^4 ml/ft^3).

C_o= 3.15 X 10^{-5} uCi/ml

λ = ventilation constant = 0.693/turnover halftime

C = 3.5 X 10^{-5}uCi/ml X $e^{-0.693 \text{ X } 18/1.75}$

C = 2.8 X 10^{-8}uCi/ml

VII. Unrestricted Area

All of the exhausted air from both the imaging room and the hot lab is released into an unrestricted area located 10 feet above the ground in an unrestricted and normally unoccupied parking area. The exhaust vent is greater than 75 feet from any return air vents. Windows in this Hospital are never allowed to be opened.

The maximum concentration of Xenon-133 averaged over a period of one year for this unrestricted area is given by the equation $C = A/V$, where:

A = Activity released per year which assumes a maximum of 100 mCi/week. A maximum escape fraction of 0.25 is very conservative.

V = Volume of air released per year @ 400 cubic feet per minute (CFM) minimum exhaust rate.

C = The maximum concentration of Xenon-133 averaged over one year.

$A = 100\text{mCi} \times 0.25 \times 52\ \text{wk/yr} \times 10^{3}\text{uCi/mCi} = 1.3 \times 10^{6}\ \text{uCi/yr.}$

$V = 400\ \text{CFM} \times 1.7 \times 10^{6}\text{ml/hr}/(\text{CFM} \times 168\ \text{Hr/Wk} \times 52\ \text{wk/yr})$
$V = 5.9 \times 10^{12}\ \text{ml/year}$

$C = 1.3 \times 10^{6}\ \text{uCi}/5.9 \times 10^{12}\text{ml} = 2.2 \times 10^{-7}\ \text{uCi/ml.}$

This shows that the exhausted air will be less than the MPC allowed of 3×10^{-7} uCi/ml as stated in 10 CFR.

VIII. The Disposal Phase

The disposal of the Xenon-133 gas will be done by exhausting the Xenon collection bag through the Nuclear Associates Gas Trap Model 36-023L. The potential leakage of Xenon 133 from this unit, as well as other sources of leakage, are included in the escape fraction of 0.25. The manufacturer states the trap has a 99% Xenon removal efficiency.

IX. Quality Control Procedures

1. The ventilation study valve will be checked prior to use to ensure proper operation. The manufacturer's operating insturctions will be followed.

2. The collection bag used for each study will be checked for leakage prior to the study. This will be accomplished by filling with oxygen.

3. All exhaust vents will be checked twice a year to confirm their continued efficiency. In addition they will be checked whenever structural changes are made which could effect their efficiency. Records verifying these procedures will be maintained.

4. All imaging equipment and dose analysis equipment quality control procedures are followed per our current license agreement.

5. The Nuclear Associates Xenon air monitor will be accuracy checked annually by 3 known different concentrations of Xenon. These "standards" are unused and partially decayed capsules opened into volumes to give the desired concentrations. Measurements that deviate by greater than 10% from the "standard concentrations" will be retested.

   The instrument will be adjusted or repaired if successive measurements deviate by greater than 10% from the expected concentration. A constancy check source will be placed at a certain geometry near the detector soon after each calibration. A constancy test will be made at least weekly and recorded. Deviations greater than 10% will indicate the need for recalibration, adjustment or repair.

6. The Nuclear Associates gas trap will have a replacement charcoal cartridge pack changed before the used filter saturates as indicated on the elapsed time meter (refer to page 15). Used cartridges will be stored in the fume hood for a minimum of ten halflives and checked with a low level survey meter before disposing in normal trash.

New England Nuclear

XENON Xe 133 GAS

Catalog Number NRP-127

DESCRIPTION

Xenon Xe 133 for diagnostic use is available as 5% gas in carbon dioxide diluent 95%.

ACTIONS

Xenon Xe 133 is a readily diffusible gas which is neither utilized nor produced by the body. It passes through cell membranes and freely exchanges between blood and tissue. It tends to concentrate more in body fat than in blood, plasma, water or protein solutions. In the concentrations used for diagnostic purposes it is physiologically inactive. Inhaled Xenon Xe 133 gas will enter the alveolar wall and enter the pulmonary venous circulation via the capillaries. Most of the Xenon Xe 133 that enters the circulation from a single breath is returned to the lungs and exhaled after a single pass through the peripheral circulation.

INDICATIONS

Inhalation of Xenon Xe 133 gas has proved valuable for the evaluation of pulmonary function and for imaging the lungs. It may also be applied to assessment of cerebral flow.

CONTRAINDICATIONS

To date, no known contraindications to the use of Xenon Xe 133 gas have been reported.

WARNINGS

This radiopharmaceutical should not be administered to pregnant or lactating women unless the benefits to be gained outweigh the potential hazards.

Ideally, examinations using radiopharmaceuticals, especially those elective in nature, of a woman of childbearing capability should be performed during the first few (approximately 10) days following the onset of the menses.

Radiopharmaceuticals should be used only by physicians who are qualified by specific training in the safe use and handling of radionuclides produced by nuclear reactor or particle accelerator, and whose experience and training have been approved by the appropriate governmental agency authorized to license the use of radionuclides.

PRECAUTIONS

As in the use of any other radioactive material care should be taken to insure minimum radiation exposure to the patient, consistent with proper patient management, and to insure minimum radiation exposure to occupational workers. Expired Xenon Xe 133 gas should be controlled in a manner that is in compliance with the appropriate governmental agency regulations.

Xenon Xe 133 adheres to some plastics and rubber and should not be allowed to stand in tubing or respirator containers. Such unrecognized loss of radioactivity from the dose for administration may render the study non-diagnostic. Xenon Xe 133 gas delivery systems, i.e., respirators or spirometers, and associated tubing assemblies must be leak proof to avoid loss of radioactivity into the laboratory environs not specifically protected by exhaust systems.

ADVERSE REACTIONS

To date, no adverse reactions based on the use of Xenon Xe 133 gas have been reported.

DOSAGE AND ADMINISTRATION

Xenon Xe 133 gas is administered by inhalation from closed respirator systems or spirometers.

The suggested activity range employed for inhalation by the average adult patient (70kg) is:

Pulmonary function including imaging: 2-30mCi in 3 liters of air.

Cerebral blood flow: 10-30mCi in 3 liters of air.

The patient dose should be measured by a suitable radioactivity calibration system immediately prior to administration.

PHYSICAL CHARACTERISTICS

Xenon Xe 133 decays by beta and gamma emissions with a physical half-life of 5.27 days[1]. Photons that are useful for imaging studies are listed in Table I.

Table I

Principal Radiation Emission Data Xenon Xe 133

Radiation	Mean % per Disintegration	Mean Energy (keV)
Beta-2	99.3	100.6
Gamma-2	34.99	81.0
K int. con. electrons, -2	47.24	45.0
L int. con. electrons, -2	7.87	75.7
M int. con. electrons, -2	9.84	80.0
K X-rays	34.70	30.8
K X-rays	7.67	35.2

(1) Dillman, L.T., Radionuclide Decay Schemes and Nuclear Parameters for Use in Radiation-Dose Estimation, Part 2, Supplement No. 4, MIRD pamphlet No. 6, J. Nucl. Med., p. 28, 1970.

The specific gamma ray constant for Xenon Xe 133 is 0.44R/mCi-hr at 1cm. The half value layer is 1mm of Pb. To correct for physical decay of this radionuclide, the fractions that remain at selected time intervals before and after the date of calibration are shown in Table II.

Table II

Xenon Xe 133 Physical Decay Chart

(Half-life 5.27 days)

Day	Fraction Remaining	Day	Fraction Remaining
-5	1.930	8	.349
-4	1.693	9	.302
-3	1.483	10	.268
-2	1.300	11	.235
-1	1.140	12	.206
0*	1.000	13	.181
1	.877	14	.159
2	.769	15	.139
3	.674	16	.122
4	.591	17	.107
5	.518	18	.094
6	.454	19	.082
7	.398	20	.072

*Calibration Day

RADIATION DOSIMETRY

The estimated absorbed radiation doses[2] to an average patient (70kg) for pulmonary perfusion and cerebral blood flow studies from a maximum dose of 30 millicuries of Xenon Xe 133 in 3 liters of air are shown in Table III.

Table III
Radiation Doses

	Effective Half-time	Lungs*	Brain	Whole Body
		rads/30mCi		
Pulmonary Perfusion	2 min.	0.25	0.0014	0.0027
Cerebral Blood Flow	5 min.	0.63	0.0035	0.0068

*99% of activity is in lungs

(2) Method of Calculation: A Schema for Absorbed-Dose Calculation for Biologically Distributed Radionuclides, Supplement No. 1, MIRD pamphlet No. 1, J. Nucl. Med., p. 7, 1968.

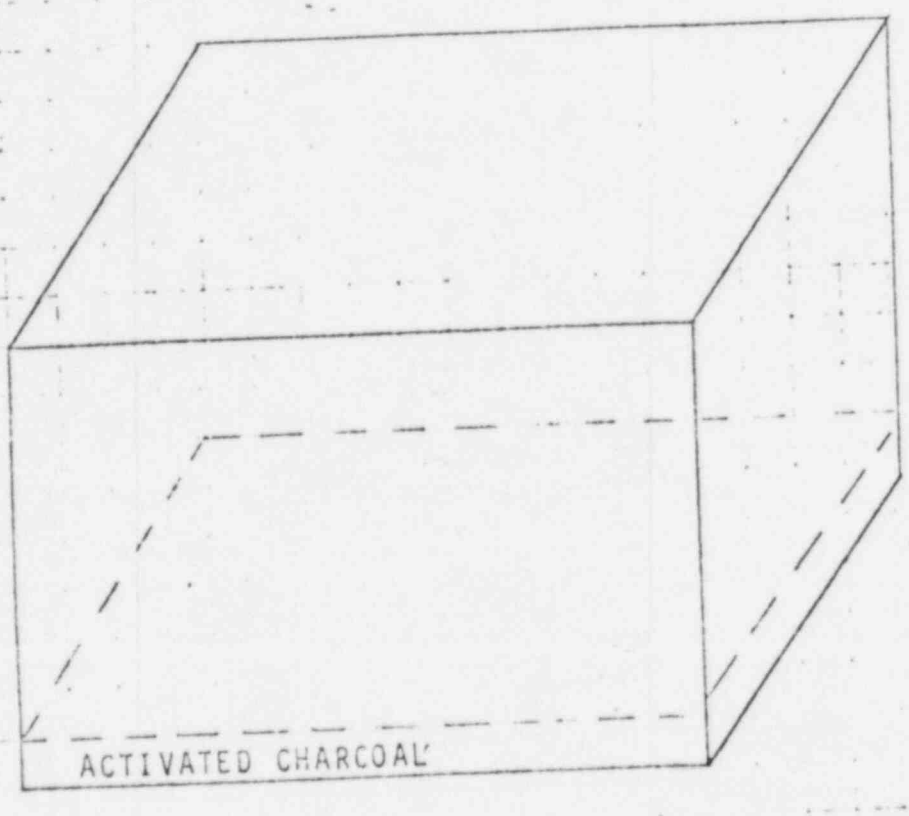
HOW SUPPLIED

The Xenon Xe 133 gas is supplied as part of the CALIDOSE™ system, consisting of 2ml unit dose vials and the CALIDOSE dispenser* for shielded dispensing. Normally vials containing either 10 or 20mCi/vial, packed up to 5 vials per shield tube, are supplied. Vial sets containing up to 100mCi/vial are available.

*Patent Pending

NEN New England Nuclear
Radiopharmaceutical Division
Atomlight Place, North Billerica, Mass. 01862

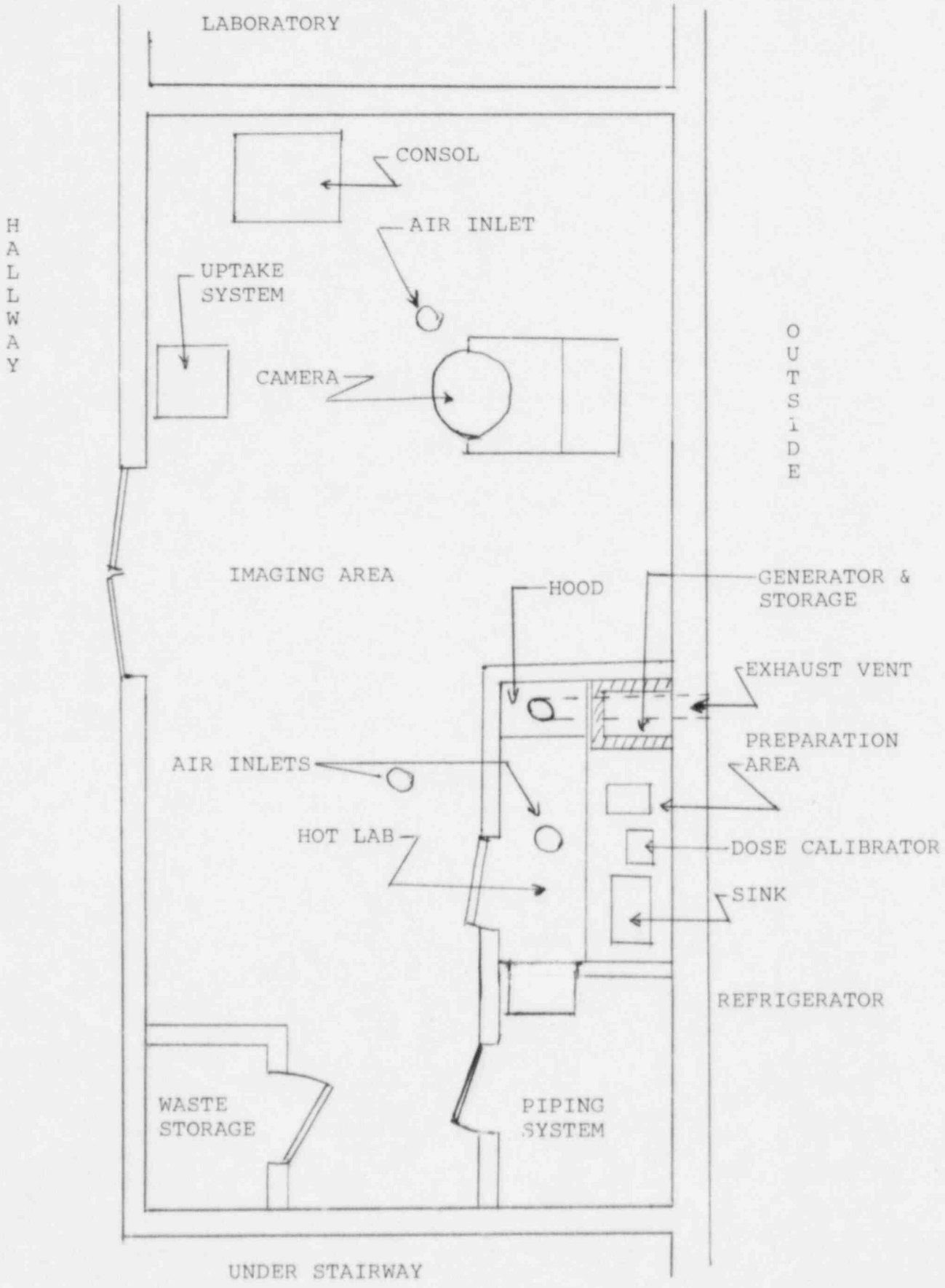
Figure 1



Xenon Xe-133 gas storage vessel

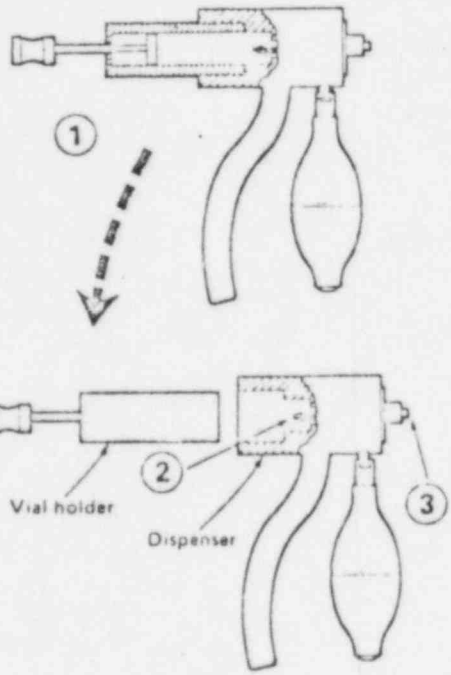
-Lined with 1/8" lead sheet
-Activated charcoal separated from Xenon lead pig with wire mesh
-Lid has rubber seal and is fastened to vessel with external clip

*Storage vessel is actually a recycled ammunition box (metal)


LABORATORY
CONSOL
AIR INLET
UPTAKE SYSTEM
CAMERA
HALLWAY
OUTSIDE
IMAGING AREA
HOOD
GENERATOR & STORAGE
EXHAUST VENT
PREPARATION AREA
AIR INLETS
HOT LAB
DOSE CALIBRATOR
SINK
REFRIGERATOR
WASTE STORAGE
PIPING SYSTEM
UNDER STAIRWAY

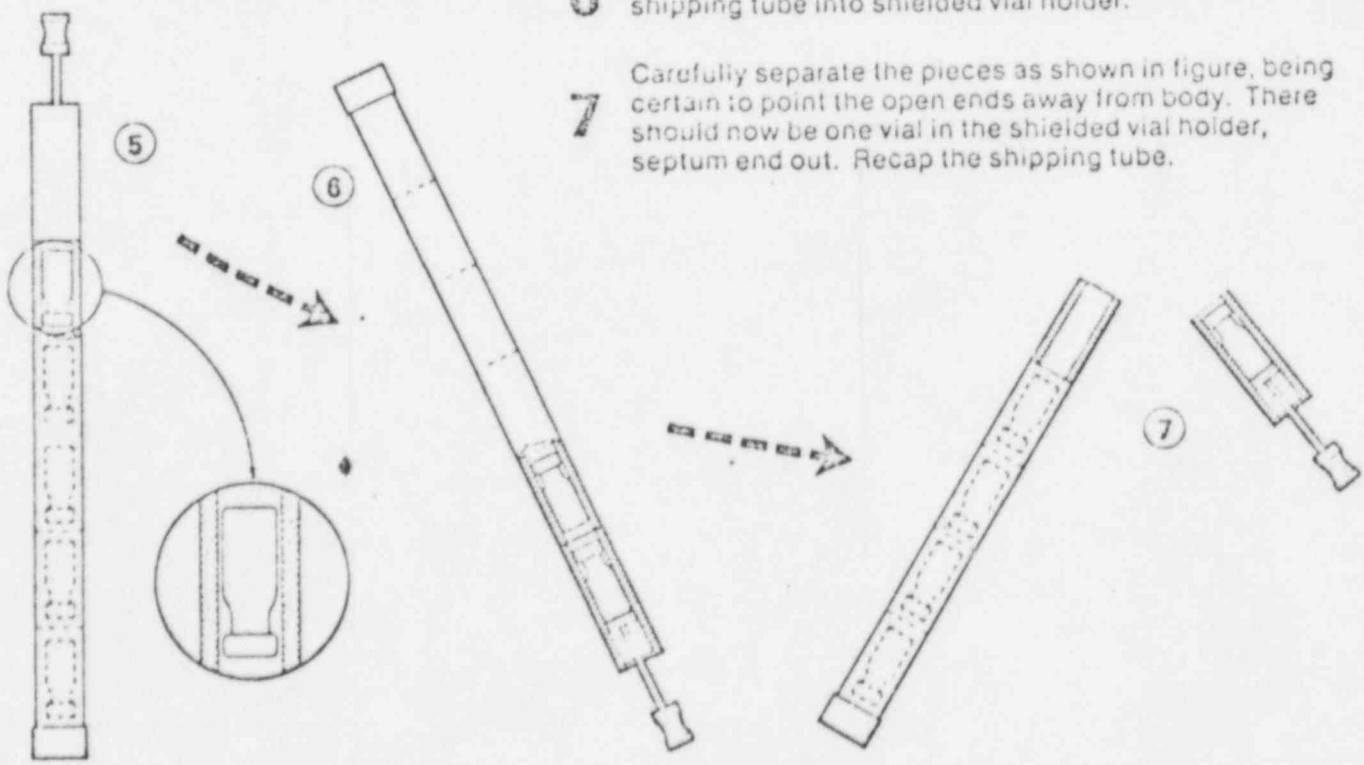
10064

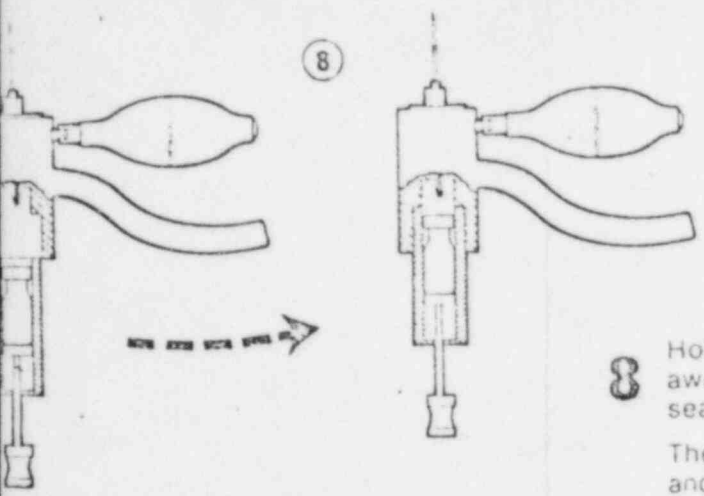
Operation Instructions for NRP-186 CALIDOSE™ DISPENSER for use with NRP-127 XENON Xe 133 GAS



Loading

1. Separate shielded vial holder from dispenser.
2. Check Huber point needles inside the dispenser body to insure that they are not blocked (if necessary, clean by pushing a fine wire through needles).
3. Attach a hypodermic needle (or other connector) securely to Luer Lock fitting on front end of dispenser.
4. Remove the yellow cap of the ^{133}Xe lead shipping tube, being careful to point opened tube away from body.
5. Place the open end of the shielded vial holder tightly against the open end of the shipping tube.
6. Simultaneously invert both to allow one vial to slip from shipping tube into shielded vial holder.
7. Carefully separate the pieces as shown in figure, being certain to point the open ends away from body. There should now be one vial in the shielded vial holder, septum end out. Recap the shipping tube.

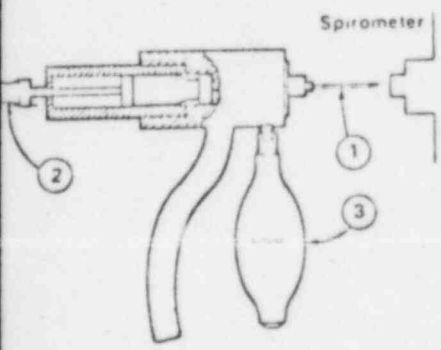




8 Holding the shielded vial holder upright (and pointed away from body), insert it into the dispenser until seated. DO NOT PUSH PLUNGER IN AT THIS TIME.

The loaded CALIDOSE Dispenser is now ready for use and can be put aside until needed. Note that appropriate radiation protection precautions must be taken since radiation can escape from the front of the unit.

Using



1 Affix the CALIDOSE Dispenser to a spirometer or related breathing apparatus.

2 Puncture septum of loaded vial by pushing plunger into dispenser.

3 Immediately squeeze the rubber bulb, and then release.

4 Detach CALIDOSE assembly from breathing apparatus.

Storing

Remove vial holder from dispenser. The previously used vial will not contain enough residual ^{133}Xe to be harmful, and may be removed by hand for disposal in the radioactive waste. Replace vial holder in dispenser for easy storage.

Statement

This CALIDOSE™ Dispenser is a device protected by U.S. Patent 3,848,773 and other patents are pending. It is to be used solely for the purposes of dispensing New England Nuclear's Xenon 133 gas Catalog Number NRP-127 as defined in New England Nuclear's NDA No. 17-284 submission. This device remains the sole property of New England Nuclear, and must be returned to New England Nuclear, Atomlight Place, North Billerica, Mass. 01862, should it cease to be used as described.

An economical approach to ventilation and perfusion studies

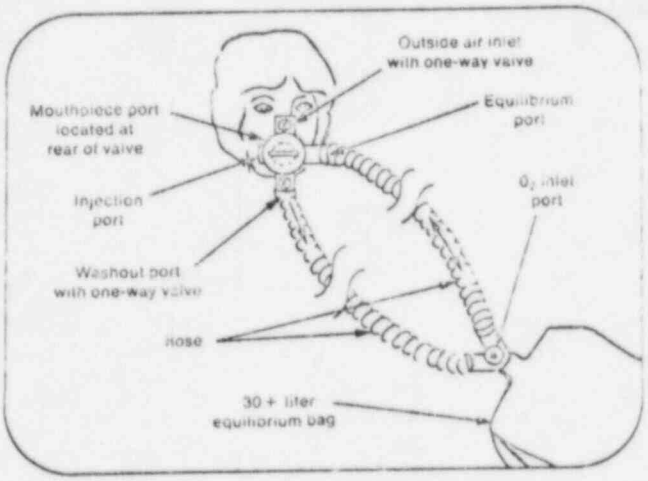
"E-Xe-BREATHE"
Disposable Xenon Re-Breathing System

- Completely self-contained, lightweight.
- Large reservoir (30+ liters, neutral volume) for equilibrium and washout.
- Simple to operate . . . economical to use.
- Special, re-usable, two-way rotary valve control.

"E-Xe-Breathe" provides a safe, low-cost method of performing perfusion and ventilation studies using any radioactive gas. It is the ideal system for the budget-conscious nuclear medicine department when the use of more expensive equipment is unwarranted.

The system is lightweight, self-contained, and easy to operate. It comes complete with a disposable 30+ liter equilibrium bag, intake and exhaust tubing, an 0_2 port, a xenon injection port, and a mouthpiece. A specially-designed, two-way rotary valve assembly for controlling the gas mixture and patient breath flow completes the system.

The re-usable, two-way rotary valve allows the patient to breathe either on a closed-loop equilibrium cycle or in a washout mode. In the latter, the patient breathes outside air only, exhaling into the equilibrium bag. The exhaust lines provide a convenient drain for the inherent xenon-air mixture. Oxygen may be added to the system through the 0_2 access port at the technologist's discretion. The xenon injection port accepts any xenon delivery system currently available.

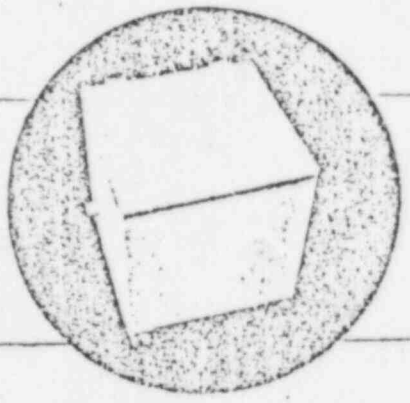


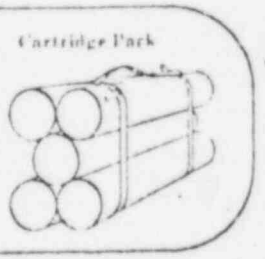
Available with or without rotary valve assembly. Bag and tubing are easily mated to rotary valve. Net weight 1 lb.

36-204	"E-Xe-Breathe" Disposable Xenon System, complete with re-usable Rotary Valve Assembly	$00.00
36-200	"E-Xe-Breathe" Disposable Bags, with tubing and connector	12.00
	12 or more ..... each	10.00

Xenon-133

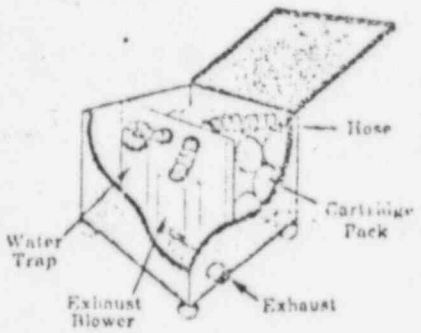
The "NONEX"™ XENON GAS TRAP*





REMOVES RADIOACTIVE XENON FROM EXHALED AIR

- Compatible with any xenon-133 gas handling system.
- Disposable 5-cartridge tandem filter removes all radioactive xenon from exhaled air.
- Compact...measures only 15" x 15" x 15¼". Rolls easily on 2" casters for convenient mobility.



*TM Nuclear Associates Inc. *Patent Pending*

The efficient removal and containment of radioactive gases from exhaled air used in nuclear-medical studies is facilitated through the use of the "Nonex" Xenon Gas Trap.

The trap is designed specifically to adsorb inert radioactive gases such as ^{133}Xe. It removes ^{133}Xe from any exhaust flow yielding an effluent concentration less than 1×10^{-6} μCi/cm^3 throughout the useful life of its disposable filter cartridges. The 5-cartridge tandem pack provides a low-velocity flow path and sufficient dwell time to effectively strip the xenon gas from the effluent stream. A charcoal adsorbent, especially formulated for xenon removal, guarantees high efficiency.

Exhaled air is drawn by a vacuum pump through five fixed charcoal-filter cartridges. The ^{133}Xe remains in the cartridges and decays. Cartridge life is dependent upon usage; a nomogram relates usage to lifetime. Typically, 20 mCi of ^{133}Xe per day with a 50-liter washout, five days per week, anticipates a cartridge life of approximately six months.

Competitive systems use a single filter cartridge having a limited adsorbitive lifetime which, when exhausted, cannot be conveniently replaced. The 5-cartridge tandem pack in the "Nonex" can be changed in seconds.

This self-contained mobile trap can be integrated into any ^{133}Xe system or may be used independently as a patient exhalation unit with the use of a disposable face mask. It is fully shielded with a ⅛" lead barrier surrounding the cartridge pack, making external radiation levels negligible. An internal cartridge on the input line, when filled with a desiccant, serves as a water trap. The unit may be used as a convenient seat for the upright patient or may be easily rolled on its casters beneath an imaging table for supine studies.

Low cost, simple operation, and high efficiency make the "Nonex" Trap an ideal alternative to costly exhaust systems.

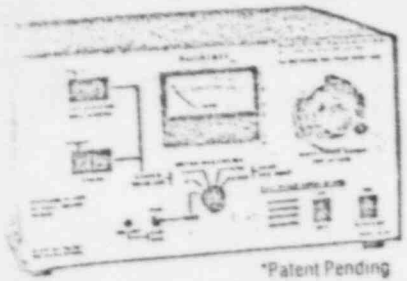
Mounted on four 2" casters for easy, silent mobility. Includes: on-off switch, water trap, and 5-liter/minute vacuum pump. 115V, 60 Hz. 15" L x 15" W x 15¼" H. Net weight 105 lbs.

36-022 "Nonex" Xenon Gas Trap	$950.00
36-026 Replacement Cartridge Pack	275.00

*Maximum permissible concentration in a controlled area, per Title 10 CFR 20, Appendix B, Table I, Column 1.

NUCLEAR ASSOCIATES, INC.
Subsidiary of
RADIATION-MEDICAL PRODUCTS CORP.
100 VOICE ROAD • CARLE PLACE, N.Y. 11514 • (516) 741-6360

2-176 Bulletin 125-H



*Patent Pending
**Nuclear Associates

UNIQUE NEW "XenAlert"™* ^{133}Xe Room Air/Trap Monitor

The only instrument that monitors exposure rate, continuously integrates and displays the xenon concentration of room air, in multiples of the Maximum Permissible Concentration (MPC)', and also monitors the effluent from xenon gas traps.

...rge meter reads directly in MPC units.
...igital register shows integrated MPC-Hours.
...dio and visual alarms alert personnel to hazardous xenon ...ncentrations. • Compatible with all xenon systems.

...w, concentrations of xenon-133 in room air and gas trap ...uent can be quantitatively monitored continuously and ...curately with the unique "XenAlert" Monitor. Unlike preset ...n-integrating devices, the "XenAlert" eliminates tedious and ...plex calculations by automatically computing total exposure (MPC-Hours units) and exposure rate (in fractions of MPC). ...on monitoring has never been easier!

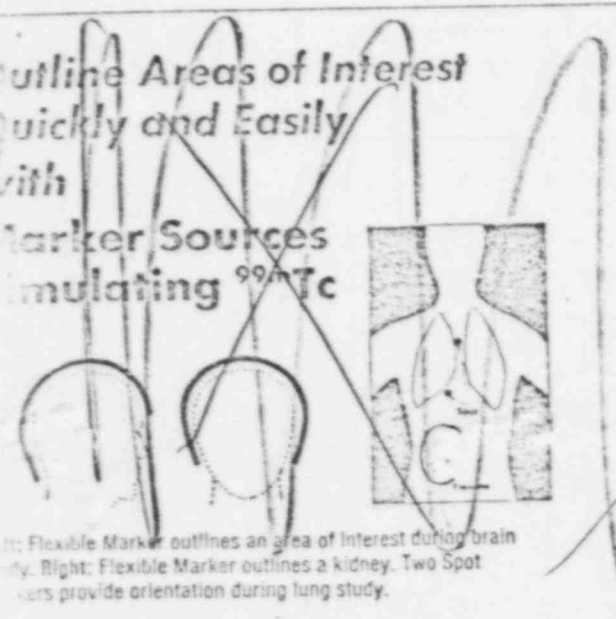
The Code of Federal Regulations† clearly limits the permissible ^{133}Xe exposure to 1 MPC for 40 hours per week for 13 weeks. The MPC-Hours are continuously updated and displayed by the "XenAlert" Monitor.

†10 CFR, Part 20, Sec. 20.103 and Appendix B, Table 1.

Detector: 5-cm (2") diam. pancake thin window GM tube.
Accuracy: Better than 20%. Reproducibility: Better than 5%.
Calibration Factors [μCi/ml]: 10^{-4} (X1), 10^{-5} (X10), 10^{-6} (X100), 10^{-7} (X1000).
Counting Chamber: Shielded with 9.5 mm (¾") lead.
MPC Meter: Ranges 1, 10, 100 and 1000 MPC.
MPC-Hours Register: 0-99, 2-digit light-emitting diode.
Hours Register: 0-80, 2-digit light-emitting diode.
Visual Alarm: LED registers flash at 1/sec rate at full-scale meter reading in X1 or X10 ranges.
Audio Alarm: Intermittent tone. User-selectable to alarm at 1 MPC or 10 MPC level.
Emergency Audio Alarm: Continuous tone on reaching 80 MPC-Hours.
Background Subtract Circuit: Enables user to adjust subtracted background.
Memory Storage Circuit: Retains accumulated data.
Size: 17 cm H x 31 cm W x 27 cm D. Weighs 23 kg. 115V, 60 Hz, 25 W.

36-751L "XenAlert" ^{133}Xe Room Air/Trap Monitor $1600.00

...utline Areas of Interest ...uickly and Easily ...ith ...larker Sources ...mulating ^{99m}Tc



...t: Flexible Marker outlines an area of interest during brain ...y. Right: Flexible Marker outlines a kidney. Two Spot ...ers provide orientation during lung study.

FLEXIBLE MARKER

Easily formed into shapes for outlining areas such as the liver, kidney, thyroid, heart or brain. Contains ^{99}Co dispersed uniformly in an epoxy matrix in a long, thin plastic tube. Can be held in place with tape. Size 0.6 mm I.D. x 2.3 mm O.D. Active length 50 cm.

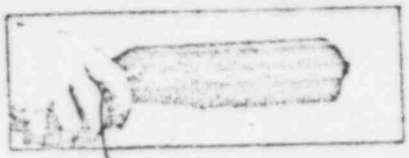
67-284L Flexible Marker Source, 50μCi ..... $60.00†
67-283L Flexible Marker Source, 150μCi ..... 72.00†

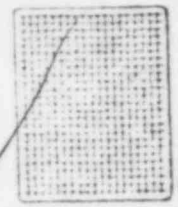
SPOT MARKER

Contains ^{99}Co in a 3-mm spot of epoxy, set in a clear lucite disc, 6 mm thick x 25 mm diam. Easily taped to patient for orientation during a scan.

67-288L Spot Marker Source, 25 μCi ..... $38.00†
67-289L Spot Marker Source, 50 μCi ..... 43.00†

†NRC (or Agreement State) license required.
Send copy of license with order.





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COMPACT, EASY-TO-USE

Cassette-and-Screen Quality Assurance Kit

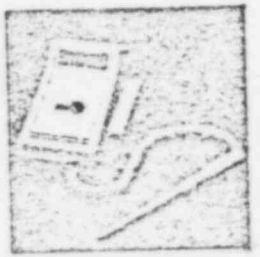
Film/screen contact, screen defects, dirt and/or stains affect radiographic quality. By using the Film/Screen Contact Mesh and the "Screen-Check" Lamp, the technologist can quickly and easily determine if cassette and screen problems exist. The Contact Mesh is placed over the cassette and radiographed. Blurring of the mesh image indicates poor film/screen contact. Screen defects are identified by illuminating the screens with the special ultraviolet lamp.

07-621L Cassette-and-Screen QA Kit. Includes Film/Screen Contact Mesh and "Screen-Check" UV Lamp $99.00
07-600L Cassette Film/Screen Contact Mesh.
14 x 17 copper, embedded in plastic for long life 45.00
07-500L "Screen-Check" UV Lamp Assembly. UL-listed.
115VAC, 50/60 Hz. 10½" x 2" x 1⅝" 70.00

Is Your Film Processor "Temp"-eramental?

Check Developer Temperature Quickly And Accurately With The NEW LOW-COST

DIGITAL THERMOMETER



The hand-held Digital Thermometer is a battery-operated unit with an immersion probe. L.E.D. display shows temperature readings in Centigrade or Fahrenheit with ±0.5°F accuracy. Eliminates inaccuracies and potential problems resulting from the misreading of stem-type thermometers.

07-402L Digital Thermometer $95.00

(16)