24-16281-01
030-10721

FORM NRC-313M (8-78) 10 CFR 35	U.S. NUCLEAR REGULATORY COMMISSION APPLICATION FOR MATERIALS LICENSE – MEDICAL	Approved: GAO R0557

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

Columbia Regional Hospital
404 Keene Street
Columbia, Missouri 65201

TELEPHONE NO.: AREA CODE (314) 875 9000

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

Daniel A. Davis, Consultant
Nuclear Medicine Assoc., Inc.
TELEPHONE NO.: AREA CODE (216) 663 7000

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

a. ☐ NEW LICENSE
b. ☒ AMENDMENT TO LICENSE NO. 24-16281-01
c. ☐ RENEWAL OF LICENSE NO. _____

4. INDIVIDUAL USERS *(Name individuals who will use or directly supervise use of radioactive material. Complete Supplements A and B for each individual.)*

Amend to add physician
Refer to Item #8

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.)*

George P. Wilson with consultation
Nuclear Medicine Assoc., Inc.
Cleveland, Ohio 44125

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		
10 CFR 35.100, SCHEDULE A, GROUP I		AS NEEDED
10 CFR 35.100, SCHEDULE A, GROUP II		AS NEEDED
10 CFR 35.100, SCHEDULE A, GROUP III		
10 CFR 35.100, SCHEDULE A, GROUP IV		AS NEEDED
10 CFR 35.100, SCHEDULE A, GROUP V		AS NEEDED
10 CFR 35.100, SCHEDULE A, GROUP VI		

ADDITIONAL ITEMS:	MARK ITEMS DESIRED "X"	MAXIMUM POSSESSION LIMITS (In millicuries)
IODINE-131 AS IODIDE FOR TREATMENT OF HYPERTHYROIDISM		
PHOSPHORUS-32 AS SOLUBLE PHOSPHATE FOR TREATMENT OF POLYCYTHEMIA VERA, LEUKEMIA AND BONE METASTASES		
PHOSPHORUS-32 AS COLLOIDAL CHROMIC PHOSPHATE FOR INTRACAVITARY TREATMENT OF MALIGNANT EFFUSIONS.		
GOLD-198 AS COLLOID FOR INTRACAVITARY TREATMENT OF MALIGNANT EFFUSIONS.		
IODINE-131 AS IODIDE FOR TREATMENT OF THYROID CARCINOMA		
XENON-133 AS GAS OR GAS IN SALINE FOR BLOOD FLOW STUDIES AND PULMONARY FUNCTION STUDIES.	X	300

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

This amendment request is for the addition of physician, use of Xenon-133, and the use of digital dosimeters under certain conditions.

RECEIVED BY LFMB
Date 7/21/82
Log Tulsa 136
By

Applicant
Check No. 2410.4
Amount/Fee Category 340-3B
Type of Fee Amend
Date Check Rec'd 7/21/82
Received By

FORM NRC-313M (8-78)
Orig. To
Action Compl.

Control No. 06640

JUL 16 1982

8506040321 850515
REG3 LIC30
24-16281-01 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: _____

7. MEDICAL ISOTOPES COMMITTEE	**15. GENERAL RULES FOR THE SAFE USE OF RADIOACTIVE MATERIAL** *(Check One)*
☐ Names and Specialties Attached; and	☐ Appendix G Rules Followed; or
☐ Duties as in Appendix B; or *(Check One)*	☐ Equivalent Rules Attached
☐ Equivalent Duties Attached	**16. EMERGENCY PROCEDURES** *(Check One)*
8. TRAINING AND EXPERIENCE	☐ Appendix H Procedures Followed; or
X Supplements A & B Attached for Each Individual User; and	☐ Equivalent Procedures Attached
☐ Supplement A Attached for RSO.	**17. AREA SURVEY PROCEDURES** *(Check One)*
9. INSTRUMENTATION *(Check One)*	☐ Appendix I Procedures Followed; or
☐ Appendix C Form Attached; or	☐ Equivalent Procedures Attached
☐ List by Name and Model Number	**18. WASTE DISPOSAL** *(Check One)*
10. CALIBRATION OF INSTRUMENTS	☐ Appendix J Form Attached; or
☐ Appendix D Procedures Followed for Survey Instruments; or *(Check One)*	☐ Equivalent Information Attached
☐ Equivalent Procedures Attached; and	**19. THERAPEUTIC USE OF RADIOPHARMACEUTICALS** *(Check One)*
☐ Appendix D Procedures Followed for Dose Calibrator; or *(Check One)*	☐ Appendix K Procedures Followed; or
☐ Equivalent Procedures Attached	☐ Equivalent Procedures Attached
11. FACILITIES AND EQUIPMENT	**20. THERAPEUTIC USE OF SEALED SOURCES**
☐ Description and Diagram Attached	☐ Detailed Information Attached; and
12. PERSONNEL TRAINING PROGRAM	☐ Appendix L Procedures Followed; or *(Check One)*
☐ Description of Training Attached	X Equivalent Procedures Attached
13. PROCEDURES FOR ORDERING AND RECEIVING RADIOACTIVE MATERIAL	**21. PROCEDURES AND PRECAUTIONS FOR USE OF RADIOACTIVE GASES (e.g., Xenon – 133)**
☐ Detailed Information Attached	X Detailed Information Attached
14. PROCEDURES FOR SAFELY OPENING PACKAGES CONTAINING RADIOACTIVE MATERIALS *(Check One)*	**22. PROCEDURES AND PRECAUTIONS FOR USE OF RADIOACTIVE MATERIAL IN ANIMALS**
	☐ Detailed Information Attached
☐ Appendix F Procedures Followed; or	**23. PROCEDURES AND PRECAUTIONS FOR USE OF RADIOACTIVE MATERIAL SPECIFIED IN ITEM 6.b**
☐ Equivalent Procedures Attached	☐ Detailed Information Attached

24. PERSONNEL MONITORING DEVICES

TYPE (Check appropriate box)			SUPPLIER	EXCHANGE FREQUENCY
a. WHOLE BODY	X	FILM		
		TLD		
		OTHER (Specify)	Refer to previous application	
b. FINGER		FILM	for License #24-16281-01	
	X	TLD		
		OTHER (Specify)		
c. WRIST		FILM		
		TLD		
		OTHER (Specify)		

d. OTHER (Specify)

Digital pocket dosimeter reactor experiments: Digi/microdose
number available: 2
Range: 0.01-99.99mR
Refer to attachment Item #20 for specific details for use and calibration.

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:

(2) LICENSE FEE ENCLOSED: $ _____

b. APPLICANT OR CERTIFYING OFFICIAL (Signature)

Howard [illegible]

(1) NAME (Type or Print)

(2) TITLE

c. DATE

June 9, 1982

FORM NRC-313M (8-78)

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 Form NRC-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.

FORM NRC-313M
(8-78)

Amend to add:

Physicians	Authorized users
John J. K. Loh, M.D.	Group VI Colloidal P-32 Intracavitary Treatment Colloidal Au-198 Intracavitary Treatment Sr-90 Treatment of Eye Disease

Training and Experience:

John J. K. Loh, M.D: Refer to attachments Supplement A and Supplement B

Item 8
Prepared 6/9/82
Lic. #24-16281-01

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

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
John J.K. Loh, M.D.	Missouri

3. CERTIFICATION

SPECIALTY BOARD A	CATEGORY B	MONTH AND YEAR CERTIFIED C
American Board of Radiology	in Therapeutic Radiology	December, 1975

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	Memorial Sloan-Kettering Cancer Hospital	3 years in residency in R.T.	
b. RADIATION PROTECTION	"	"	
c. MATHEMATICS PERTAINING TO THE USE AND MEASUREMENT OF RADIOACTIVITY	"	"	
d. RADIATION BIOLOGY	"	"	
e. RADIOPHARMACEUTICAL CHEMISTRY	"		

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

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION OF EXPERIENCE	TYPE OF USE
Iridium-192 Radium-226 Iodine-125 P-32 Cesium Capsules Cf.-252		Memorial Sloan-Kettering Ellis Fischel V.A. Medical Center, Allen Park, Michigan	since 1973	Permanent implantation, temporary interstitial implantation, after-loadi technique, etc.

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: John J.K. Loh, M.D.

STREET ADDRESS: 1600 E. Broadway

CITY: Columbia, MO | STATE: MO | ZIP CODE: 65201

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		Not applicable.
	DETERMINATION OF BLOOD AND BLOOD PLASMA VOLUME		
	LIVER FUNCTION STUDIES		
	FAT ABSORPTION STUDIES		
	KIDNEY FUNCTION STUDIES		
	IN VITRO STUDIES		
OTHER			
I-125	DETECTION OF THROMBOSIS		
I-131	THYROID IMAGING		
P-32	EYE TUMOR LOCALIZATION		
Se-75	PANCREAS IMAGING		
Yb-169	CISTERNOGRAPHY		
Xe-133	BLOOD FLOW STUDIES AND PULMONARY FUNCTION STUDIES		
OTHER			
Tc-99m	BRAIN IMAGING		
	CARDIAC IMAGING		
	THYROID IMAGING		
	SALIVARY GLAND IMAGING		
	BLOOD POOL IMAGING		
	PLACENTA LOCALIZATION		
	LIVER AND SPLEEN IMAGING		
	LUNG IMAGING		
	BONE IMAGING		
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	30	
I-131	TREATMENT OF THYROID CARCINOMA		
	TREATMENT OF HYPERTHYROIDISM		
Au-198	INTRACAVITARY TREATMENT	10	
Co-60 or Cs-137	INTERSTITIAL TREATMENT	250	
	INTRACAVITARY TREATMENT	250	
I-125 or Ir-192	INTERSTITIAL TREATMENT	160	
Co-60 or Cs-137	TELETHERAPY TREATMENT	Approx. 3000	
Sr-90	TREATMENT OF EYE DISEASE	5	
	RADIOPHARMACEUTICAL PREPARATION		
Mo 99/ Tc 99m	GENERATOR		
Sn 113 / In 113m	GENERATOR		
Tc 99m	REAGENT KITS		
Other			

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

January, 1973 to December, 1975 Memorial Sloan-Kettering, New York
January, 1976 to December, 1976 Ellis Fischel State Cancer Hospital, Columbia, MO
January- 1977 to March, 1982 Veteran's Administration Medical Center, Allen Park, MI

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

a. NAME OF SUPERVISOR
Nestor R. Canoy, M.D.

b. NAME OF INSTITUTION
Ellis Fischel State Cancer Hospital

c. MAILING ADDRESS
Boone Hospital Center, 1600 E. Broadway

d. CITY
Columbia, MO

5. MATERIALS LICENSE NUMBER(S)
24-01565-01

6. PRECEPTOR'S SIGNATURE

7. PRECEPTOR'S NAME (Please type or print)
Nestor R. Canoy, M.D.

8. DATE
4/30/82

Present

FORM NRC 313M SUPPLEMENT B
(8-78)

Control No. 06640

Procedures and Precautions for Use
(of Radioactive Gases (Xenon-133)

1. Quantities to be used:

   a. Patient information

      1 15 studies per week.

      2. 15mCi per patient.

2. Use and Storage Areas:

   a. The hot lab shown in the ventilation plan for this facility will be used to receive, open, store, dispense and dispose of all of the Xe-133 released to the environment. The Xenon will be stored in its original shipping safe until used. Accessary lead shielding will be used (i.e. 1/8" - 1/4" lead vials or sheet) whenever survey measurements at the surface of the safe is 2.0 mR/hr or more.

      The closest unrestricted area is the hallway. The lead shielding, wallboard construction and distance will reduce levels in the hall to well below 2.0 mR/hr except during manipulation and disposal of the gas. These time periods will be short (i.e. on the order of minutes) preventing total exposure from exceeding 2.0mR in any one hour.

   b. The exhaust systems are independent systems at this facility. The dedicated exhaust system provides an exhaust rate of 1192cfm (hot lab) and 663cfm (camera room). Discharge is to the exterior. None of the discharge is recirculated into the building. The forced air supply is 325cfm to the camera room and 150cfm to the hot lab.

   c. The hot lab and camera room are at negative pressure. The blower is on continuously. Semi-annual measurements of air flow rates will be performed.

3. Procedure for Routine Use:

   a. The camera room door will be adjusted so a sensible draft is felt at opening. The patient will be fitted with the rebreathing apparatus and instructed as to the procedure.

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A trial run will be conducted when possible. The valving and tubing will be examined for continuity. The dose will be prepared and assayed on the dose calibrator if possible. The Xenon will be administered to the patient (intravenously or into the tubing airway) and three to four views obtained. The gas will be collected in the washout bag until practically no Xenon remains in the patient as evidenced by the camera persistant scope. The gas will be shielded at all times up to patient administration except during times of transfer from the shielded vial to a shielded syringe (if used). TLD finger badges and whole body film badges will be worn by all personnel handling Xenon. Whole body badges will also be worn by all other occupational personnel present during Xenon usage. Visitors to the nuclear medicine section will be excluded from the camera room during the use of Xenon unless their presence is required or desired.

b. A Pulmonex 130-500 delivery system with charcoal trap, or equivalent system, will be used. Manufacturers instruction or equivalent procedure will be followed to determine trap saturation.

c. Face masks that cover both mouth and nose or nose clamps for use with the mouthpiece delivery systems will be employed to reduce leakage of the Xenon into the camera room.

4. Emergency Procedures:

In order to implement the ALARA philosophy directed in 10CFR20.1 (c), the accidental release of Xenon into the camera room will result in evacuation of the room for a time period if the patient's condition permits. During this time, the exhaust blower will clear the room to levels of 1×10^{-5}uCi/ml as described below and the camera room with a guarded against inadvertant entry.

a. Xenon, an inert gas, will rapidly equilibriate with the air in the camera room.

b. The exhaust blower will reduce the concentration exponentially with time given as described:

1. Room size: ∿13' x 34.7' x 8' containing 3609 $ft^3 = 1.0 \times 10^8$ml

2. Exhaust rate: 663 cfm from the camera room

3. Standard dose released in air by error = 10,000uCi

4. Acceptable concentration of Xe-133 in a restricted area = 1.0×10^{-5}uCi/ml.

Calculations:

1. Initial concentration = $\frac{10{,}000\text{uCi}}{1.0 \times 10^{8}\text{ ml}} = 1.0 \times 10^{-4}\text{ uCi/ml}$

2. Clearance rate = $\frac{663\text{ cfm}}{3609\text{ cu. ft.}} \times 100 = 18.3\ \%/\text{minute}$

3. Desirable concentration factor = $\frac{1.0 \times 10^{-5}\text{ uCi/ml}}{1.0 \times 10^{-4}\text{ uCi/ml}} = 1.0 \times 10^{-1}$

4. Time required to reduce the concentration to an acceptable level is calculated as follows:

   Concentration factor = e^{-Rt} (R = Clearance rate; t = time)

   $0.10 = e^{-.183t}$

   t = 12.5 minutes (evacuation time)

At the time of re-entry to a room following a spill, a low level survey meter will be used to check for any exposure levels above normal background. If readings above this level are noted the room will be allowed to be vented for an additional time period until the exposure level no longer continues to decline.

5. Air concentration of Xe-133 in Restricted Area:

   a. Maximum amount of activity used per week:

      A = 15mCi x 15 patients/week = 225mCi/week

   b. Assume 25% Xenon loss use, storage, and disposal:

      f = .25

   c. Volume of air available per week for dilution of Xe-133 = V

      If $\frac{A}{V} \times f \leq 1 \times 10^{-5}\text{ uCi/ml}$

      Then $V = \frac{A \times f}{1 \times 10^{-5}\text{ uCi/ml}}$

      $V = \frac{225\text{mCi} \times 1 \times 10^{3}\text{ uCi/mCi} \times .25}{1 \times 10^{-5}\text{ uCi/ml}}$

      $V = 5.62 \times 10^{9}\text{ ml/week}$

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The required ventilation rate:

$$\frac{5.62 \times 10^{9} \text{ml/week}}{40 \text{ hrs/week}} \times \frac{1 \text{ cfm}}{1.7 \times 10^{6} \text{ml/hr}} = 83 \text{ cfm}$$

The actual ventilation rate in this area is 663 cfm.

6. Method of Xenon-133 Disposal:

All Xenon unused will be disposed of by decay in storage. Containers and apparatus will be surveyed unshielded with the low level survey meter, held on contact with the source containing device. If levels are the same as background, the containers will be disposed after defacing the labels.

It is assumed that 25% of the used Xenon is vented to the exterior. This includes loss from the charcoal trap as well as leakage during storage and patient associated loses.

1. Maximum amount of Xenon-133 released per year:

$$A = \frac{15 \text{ patients}}{\text{week}} \times \frac{15\text{mCi}}{\text{patient}} \times \frac{10^{3}\text{uCi}}{\text{ml}} \times \frac{52 \text{ weeks}}{\text{year}} \times .25$$

$$A = 2.9 \times 10^{6}\text{uCi/yr}$$

2. Exhaust flow rate of 663 cfm will be used in this calculation.

3. Annual air flow:

$$V = 663\frac{\text{ft}^3}{\text{min}} \times 1.49 \times 10^{10} \frac{\text{ml/year}}{\text{ft}^3}$$

$$V = 9.9 \times 10^{12}\text{ml/year}$$

4. Annual concentration in an unrestricted area.

$$C = \frac{2.9 \times 10^{6} \text{ uCi/year}}{9.9 \times 10^{12} \text{ ml/year}}$$

$$C = 2.9 \times 10^{-7}\text{uCi/ml}$$

This quantity does not exceed 3×10^{-7}uCi/ml for an unrestricted area.

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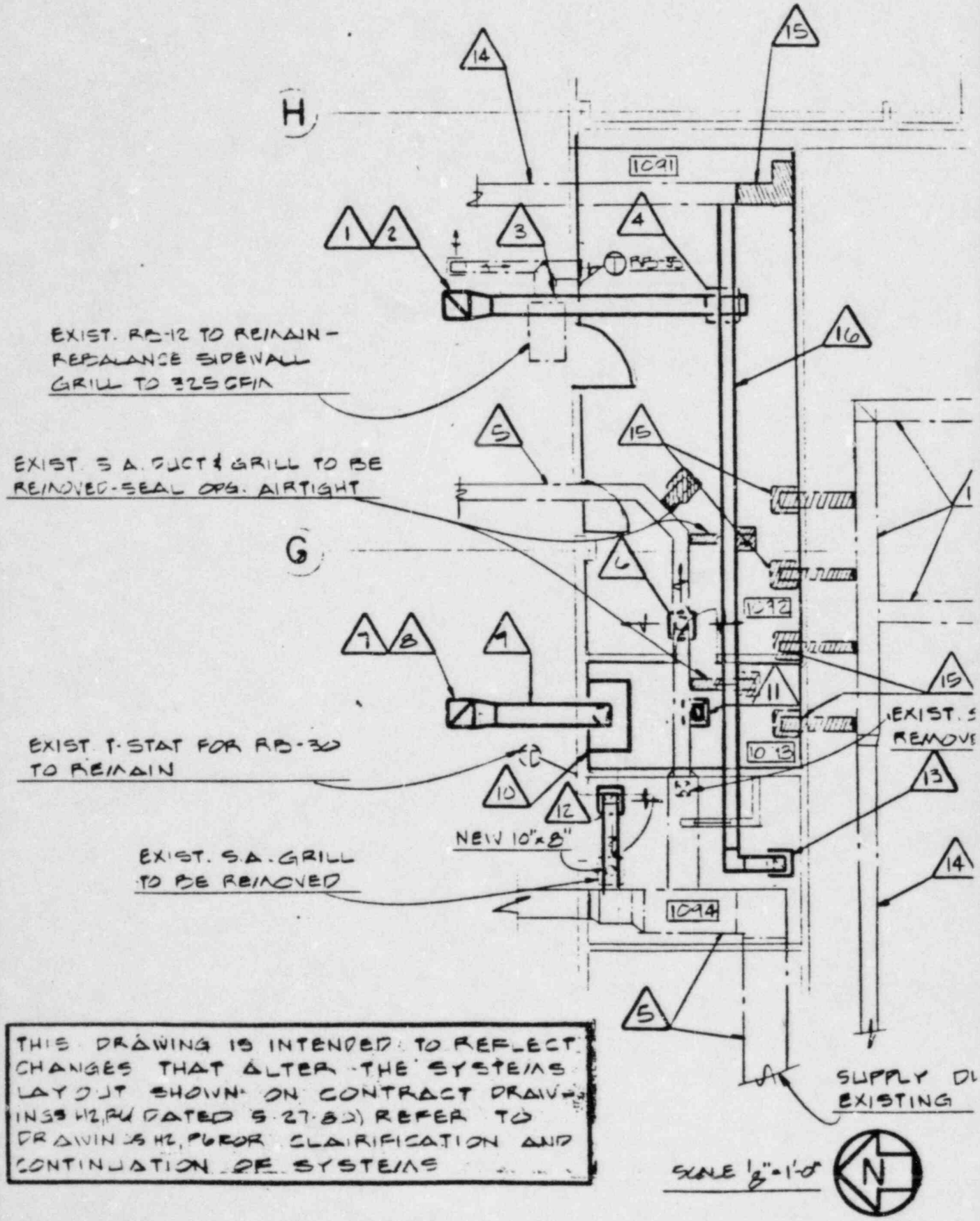
In order to detect a saturated charcoal trap, a survey will be conducted with the G-M probe held on contact with the trap inlet hose. The maximum levels will be recorded during the equalibrium phase. Room background will be taken into account. The probe will then be placed on the discharge tube. If these levels reach 10% of the intake maximums, the trap will be considered less than 90% effective and will be replaced.

This latter test will be conducted after every 20 ventilation studies.

Saturated filters will be stored for decay adequately shielded if necessary so that levels do not exceed 2.0mR/hr from the container. A survey will be conducted without the benefit of shielding and if levels are those of background, the filter may be discarded.

Roof access at this facility will be restricted to individuals who have business on the roof, i.e. maintenance.



THIS DRAWING IS INTENDED TO REFLECT CHANGES THAT ALTER THE SYSTEMS LAYOUT SHOWN ON CONTRACT DRAWINGS H2, R4 DATED 5-27-83) REFER TO DRAWING M2, P6 FOR CLARIFICATION AND CONTINUATION OF SYSTEMS

KEY NOTES —

CAMERA Room EF

1. GREENHECK MODEL CUBE 10-4, 1/4 H.P., 1205 RPM, 5510 T.S., 663 CFM @ .5 S.P., R-1 DRIVE. WITH PREFAB. CURB AND BACKDRAFT DAMPER.
2. 12"x12" EXHAUST DUCT UP THRU ROOF. ROOF OPENING TO BE 14½"x14½".
3. 12"x10" EXHAUST DUCT
4. KRUEGER MODEL ESC-5 CEILING EXHAUST GRILL 12"x12". (12"ø NECK). LOCATION SHALL BE AS DETERMINED BY LOCATION OF DETECTOR.
5. EXISTING SUPPLY AIR DUCT, TO REMAIN.

CAMERA Room Supply

6. KRUEGER MODEL SRA-4209 CEILING SUPPLY GRILL. 9"x9", 325 CFM. (9"ø NECK)

Hot Lab EF

7. GREENHECK CUBE 14-3, 2 SPEED, 1/3 H.P. 1145 R.P.M. 4384 T.S., 1192 CFM @ .75 S.P. R-3 DRIVE. WITH PREFAB. CURB AND BACKDRAFT DAMPER.
8. 16"x16" EXHAUST DUCT UP THRU ROOF. ROOF OPENING TO BE 18½"x18½".
9. 16"x12" EXHAUST DUCT.

Exhaust Hood

10. EXHAUST HOOD FURNISHED AND INSTALLED BY OTHERS. FINAL CONNECTION BY THIS CONTR.

Hot Lab Supply

11. KRUEGER MODEL SRA-4204 CEILING SUPPLY GRILL. 6"x6" 150 CFM (6"ø NECK) W/ OBD
12. KRUEGER MODEL SRA-4202 CEILING SUPPLY GRILL. 9"x9" 200 CFM (9"ø NECK)
13. KRUEGER MODEL ESC-5 CEILING EXHAUST GRILL 9"x9". BALANCE TO 180 CFM EXHAUST.
14. EXISTING EXHAUST DUCT TO REMAIN.
15. EXISTING EXHAUST DUCT BRANCH TO BE REMOVED. CAP & SEAL OPENING AIRTIGHT.
16. NEW 10"x6" EXHAUST DUCT. CONNECT TO EXIST. EXHAUST DUCT.

. GRILL TO BE
SEAL OPG. AIRTIGHT

T FROM
0-30

ADDITIONS TO
COLUMBIA REGIONAL HOSPITAL
COLUMBIA, MISSOURI

KROMM RIKIMARU AND JOHANSEN, INC.
ARCHITECTS
112 SOUTH HANLEY RD ST. LOUIS, MO.

PARTIAL FLOOR PLAN - LEVEL I - NORTH
HVAC AND MEDICAL GAS

DRAWN BY	MRW
CHECKED BY	THR
DATE	5-15-82
PROJECT NO.	7924
SHEET NO.	CO-14

Modification of Program Involving
the Therapeutic Use of Sealed Sources

In order to expedite the monitoring of non-occupaticnal personnel (i.e. nurses) caring for therapy patients, it's conceiveable that insufficient number of film badges, one to be assigend to each person, could be on hand. This situation could occur due to an unscheduled request for immediate sealed source therapy. Also, an untimely depletion of film badges could occur near the end of the month, before the monthly exchange of film badges with the film badge vendor. In such circumstances, it's requested the attached program for the use of digital pocket dosimeters be approved for emergency use and at the discretion of the Radiation Safety Officer.

Digital Dosimeter:

Reactor Experiments: Digi/MicroDose

Number Available: 2

Range: 0.01 - 99.99mR

PROPOSED PROGRAM FOR PERSONNEL MONITORING

WITH DIGITAL POCKET DOSIMETERS

1. Prior to implantation or administration of therapeutic amounts of radioactive materials, the Radiation Safety Officer or designee will instruct nursing, housekeeping and other ancillary personnel as to the particulars of this program.

2. Radiation Safety Officer will instruct and demonstrate to representatives of each shift how to:

   a. Turn Digital Pocket Dosimeter on
   b. Perform operational test
   c. How to read the unit
   d. Interpret the audible alarm
   e. Reset unit
   f. Record the results

3. For each incident of use (i.e., for each patient), a log will be kept with the following:

   a. Staff member's name
   b. Time
   c. Reading for each time staff person entered patient's room
   d. Sum of all readings for that person

4. For the purposes of this record, if more than one staff member is with the radioactive patient at any one time, the reading on the pocket dosimeter shall be entered into the log for each staff member. This provision will not be enforced if each staff member has his own digital pocket dosimeter.

5. Radiation Safety Officer shall review this log daily and, based on the recorded dose for each staff member, arrange for rotation of personnel so that no non-radiation worker receives an accumulated dose greater than 100mR/patient incident.

6. The alarm will be set at 10.24mR. Staff will be instructed that, when the alarm sounds, they should leave the patients's room as soon as possible. This is done in an effort to assure that no staff member approaches a total exposure of 100mR/incident.

7. The Radiation Safety Officer is responsible for checking the units operation prior to each use.

8. Aside from the particulars involved in the use of Digital Pocket Dosimeters, all other aspects of radiation protection with regard to non-occupational personnel will be accomplished in accordance with well established protocols, stated in the renewal application, dated 9/26/79.

CALIBRATION AND USE OF DIGITAL POCKET DOSIMETERS

Direct reading dosimeters will be calibrated at a minimum and used in accordance with the following:

a. The dosimeters are to be checked against a known source of radiation at least annually. The measured exposures are not to vary from the actual exposures by more than plus or minus 20%. Should a dosimeter's measured exposure vary by more than 20%, it shall be removed from service. In addition to the above, multiplication factors are to be attached to the dosimeters to correct for the variances between the measured and actual exposures. Copies of the calibration data are to be maintained for review by this Department's representative.

b. An annual check of the dosimeters for excess leakage of charge is also to be conducted. A dosimeter is considered to be defective if the rate of leakage is greater than 5% of the dosimeter scale reading during a 24 hour period.

c. The dosimeters are sufficiently sensitve to measure radiation exposure in millirem increments.

d. An accountability record shall be maintained indicating the names of persons wearing the dosimeters, the dates worn, the amount of radiation exposure received, and the identity of the dosimeter worn (e.g. serial number). This record is also to be available for review by this Department.

e. Each individual who will be using a direct reading dosimeter shall be instructed in the proper reading and recharging of the dosimeters.

f. Operational checks are to be performed prior to using the dosimeters to assure they have not been damaged in storage.