NRC Form 313T
(2-82)
10 CFR 35

U.S. NUCLEAR REGULATORY COMMISSION

Approved by OMB
3150-0081
Expires 1-31-85

APPLICATION FOR MATERIALS LICENSE — TELETHERAPY

INSTRUCTIONS – Complete Items 1 through 22 if this is an initial application or an application for renewal of a license. Use supplemental sheets where necessary. Item 22 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, 21, 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 22 and the appropriate fee enclosed.

RECEIVED BY LFMB
Date. 11/1/83
Log. NOV Renewal
By. Brown
Orig. To.
Action Compl.

1.a. NAME AND MAILING ADDRESS OF APPLICANT *(Institution, firm, clinic, physician, etc.)* INCLUDE ZIP CODE

Allegheny Health, Education and Research Corp.
320 East North Avenue
Pittsburgh, PA 15212

1.b. STREET ADDRESS(ES) AT WHICH RA *(If different from 1.a.)* INCLUDE ZIP CO

SAME

TELEPHONE AREA CODE (412) NUMBER 359-3131

2. PERSON TO CONTACT REGARDING THIS APPLICATION

Prakash N. Shrivastava, Ph.D.
412 359-4171
Frank P. Ottino, M.Sc. 412 359-3485

TELEPHONE AREA CODE ( ) NUMBER

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

- [ ] a. NEW LICENSE
- [X] b. AMENDMENT TO LICENSE NO. 37-01317-02
- [ ] 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.)*

Prabha Bansal, M.D. } Human Use
Julian Proctor, M.D. } CAMBRIDGE 1974, L 1974

Roy E. Summers, M.Sc.
Frank P. Ottino, M.Sc. } Non-Human Use
Prakash N. Shrivastava, Ph.D.

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.)*

Roy E. Summers, M.Sc.
Frank P. Ottino, M.Sc.

6. SEALED SOURCES TO BE USED IN TELETHERAPY UNITS *(Attach supplemental pages if necessary)*

	BYPRODUCT MATERIAL *(Element and Mass No.)*	NAME OF SOURCE MANUFACTURER	SOURCE MODEL NUMBER	MAXIMUM ACTIVITY PER SOURCE	NUMBER OF SOURCES
A.	Co-60	Teletherapy, Picker Advanced Medical Systems Inc.	P-3802 A/AMS 3802	6,500 Curies	2x
B.	Co-60	Teletherapy A.E.C.L.	C-146 or C-151	2,200 Curies	2x
C.					

7. TELETHERAPY UNITS *(Attach supplemen*

	NAME OF MANUF	MODEL NUMBER
A.	Picker Corporation	6296 (C9M/80)
B.	A.E.C.L.	Eldorado Super G
C.		

Applicant. 60506-55678
Check No. #460-3F
Amount/Fee Category. Application
Type of Fee
Date Check Rec'd. 11/1/83
Received By Brown

8. USE *(Attach supplementary pages, if necessary)*

A	B	C	
X			HUMAN USE ONLY
	X		HUMAN AND OTHER USE *(Specify on separate sheet)*

B. is to be used for non-human uses only as a calibration source in our Accredited Dosimetry Calibration Laboratory

9. PERSONNEL MONITORING DEVICES

	TYPE (Check and/or complete as appropriate)	SUPPLIER (Service Company)	EXCHANGE FREQUENCY
	(1) FILM BADGE – WHOLE BODY		
X	(2) THERMOLUMINESCENT DOSIMETER (TLD)– WHOLE BODY	R.S. Landauer, Jr. & Co.	Monthly
X	(3) OTHER *(Specify)*: TLD Ring Extremity dosimeter	R.S. Landauer, Jr. & Co.	Monthly

INFORMATION REQUIRED FOR ITEMS 10 THROUGH 21

For Items 10 through 21, 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 teletherapy licensing guide will be followed, do not submit the pages, but specifiy the revision number and date of the referenced guide: Regulatory Guide 10. Rev. _____ Date: _____

10. MEDICAL ISOTOPE COMMITTEE	15. BEAM STOPS
Names and specialties attached; and *(check one)*	X Description of stops used to restrict beam orientation attached.
a. Duties as in Appendix A, or	16. SHIELDING EVALUATION
b. Equivalent duties attached.	X Evaluation of proposed shielding attached.
11. TRAINING AND EXPERIENCE	17. OPERATING AND EMERGENCY PROCEDURES
a. Supplements A & B attached for each individual user; and	a. Description of operating procedures attached; and
b. Supplement A attached for RSO.	b. Copy of emergency procedures attached.
12. INSTRUMENTATION *(check one)*	18. INSTRUCTION OF PERSONNEL *(check one)*
a. Appendix C form attached, or	a. Training program and schedule in Appendix H followed, or
b. List manufacturer's name and model number.	b. Description of instruction program for employees attached.
13. CALIBRATION OF INSTRUMENTS *(check one)*	19. LEAK TESTS OF SEALED SOURCES
a. Appendix D, Part 2 procedures followed for instrumentation calibration, or	X Description of leak-test procedures attached.
b. Description of sources, calibration frequency and equivalent procedures attached.	20. QUALIFIED EXPERT *(Use only if the individual fails to meet 10 CFR 35.24 requirements.)*
14. FACILITIES AND EQUIPMENT	Statement of qualifications of the expert who will perform teletherapy calibrations attached.
X a. Description and drawing of facilities attached; and	21. ALARA PROGRAM *(check one)*
b. Description of patient viewing and communicating systems attached; and	X ALARA Program as in Appendix I, or
X c. Description of area safeguards attached.	Equivalent ALARA Program attached.

22. CERTIFICATE

(This item must be completed by the applicant)

The applicant and any official executing this certificate on behalf of the applicant named in Item 1a certifies 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 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)*

10-CFR-170.31 (3) (F)

(1) LICENSE FEE CATEGORY

$460.00

(2) LICENSE FEE ENCLOSED

$

b. APPLICANT OR CERTIFYING OFFICIAL *(Signature)*

John H Westerman

(1) NAME *(Type or print)*

John H. Westerman

(2) TITLE

President

c. DATE

10/17/83

WARNING: 18 U.S.C. Section 1001; Act of June 25, 1948, 62 Stat. 749, makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

Item 6:

We have requested the possession of two Co-60 sources for each Cobalt apparatus. We request this so that when the Co-60 source located in either teletherapy head decays to a level which makes it too weak for its respective function we can have a replacement source shipped and installed at the same time that deleted source is removed and shipped back to the certified vendor.

Item 11:

We wish to delete the names of Joseph P. Concannon, M.D., James M. Hughes, M.D., Peter T. Chopping, M.D., from this license (37-01317-02).

Also it is unclear as to whether the U.S. NRC will necessitate a new Cobalt-60 license for the use of the tele-calibration Cobalt-60 source. If a new license is issued we would wish that the authorized non-human use users from 37-01317-02 be added onto the new license. These individuals being Roy E. Summers, Jr., M.Sc., Frank P. Ottino, Jr., M.Sc., and Prakash N. Shrivastava, Ph.D.

Item 14: a. Facilities

The A.E.C.L. Eldorado Super G apparatus with Co-60 sealed 2,200 Curie radioactive source is to be installed on the eighth floor of the East Wing Mechanics Tower at Allegheny General Hospital. It will serve as a calibration standard for the A.A.P.M. Accredited Dosimetry Calibration Laboratory within the AHERC. The eighth floor is the upper most floor in the East Wing Mechanics Tower. The tele-calibration unit with source is planned to be installed in the northeast corner of the building such that no building structures are in close proximity to the proposed Co-60 irradiator's site to the north and east walls and the ceiling/roof above. See diagrams 1 & 2.

The south wall partitions the cobalt unit from the Co-60's restricted control panel area and a small dimensioned storage closet which lies along the west side of the south wall.

Diagram 1

Relative Positions of Mechanics East Wing Tower to Main Hospital's Tower.

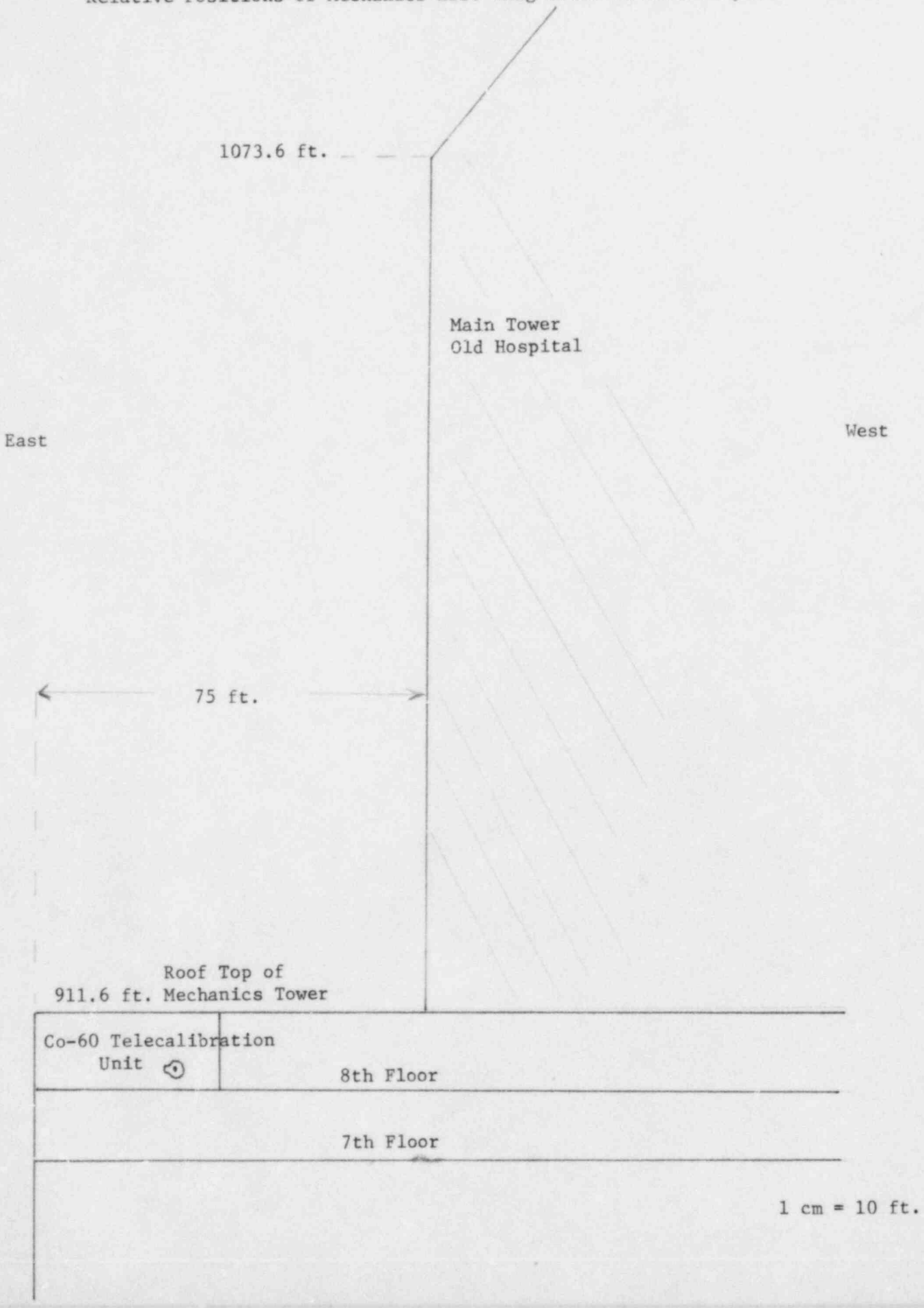
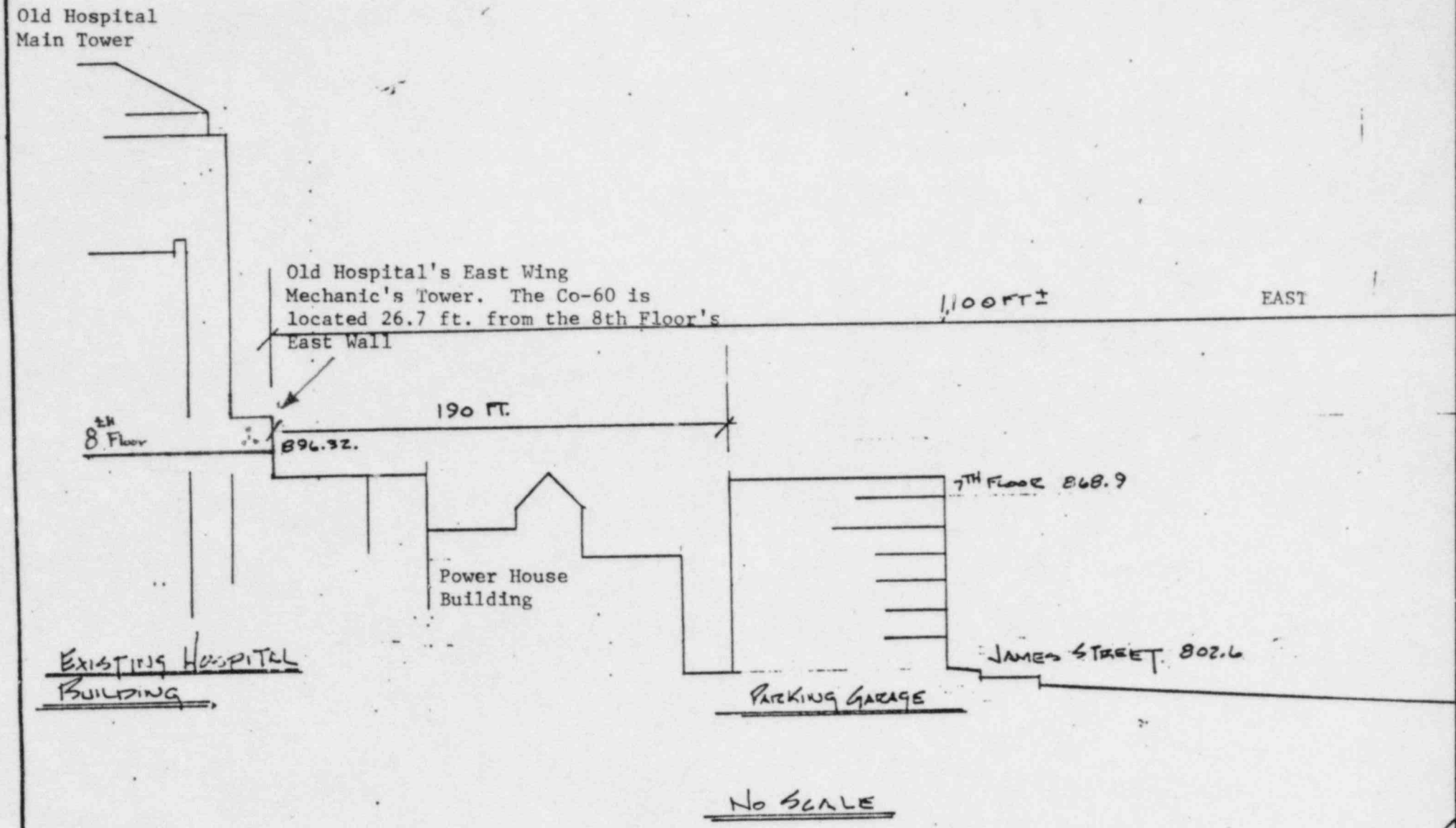


Diagram #2
Relative Position of East Wing
Mechanics Tower to other
existing hospital structures



The west wall partitians the Co-60 unit from the unrestricted radiological/medical physics conference room, beneath the Co-60 facilities lies unrestricted class rooms, offices and corridors. Above the Cobalt-60 facility is an unoccupied and unrestricted roof top area. See Diagram 3.

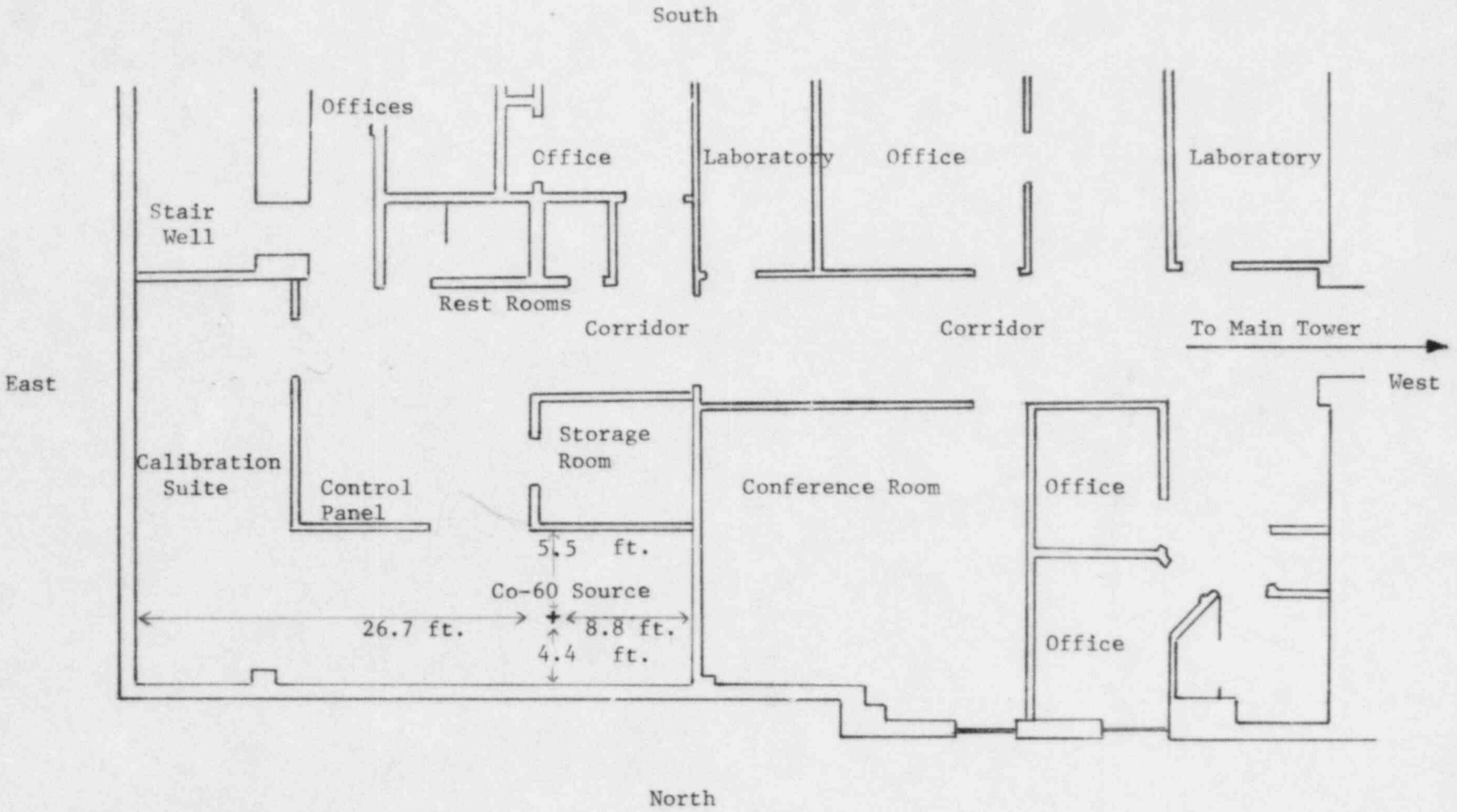
The tele-calibration beam is to be oriented and fixed along a horizontal line. Once this beam is adjusted horizontally it will be fixed in that position, thus the head/beam will not be moved, elevated, rotated, revolved, or swiveled in any direction unless it is for replacement, realignment or safety purposes. The position of the Co-60 source in its fixed/stationary position is 66 inches from the south wall, 52.8 inches from the north wall, 106 inches from the west wall, 4 feet off the floor, 11.5 feet from the roof above. See diagram 3

The beam in the "ON" position will propagate towards the east wall such that it is parallel to the north wall and perpendicular to the east wall. The distance from the north wall to the nearest occupied area to the north, the new hospital structure, is 152 feet. The distance from the east wall to the nearest structure to the east is greater than 190 feet (the parking garage).

Item 14: c. Safety and Safeguards

The Cobalt-60 tele-calibration facility is by definition a "high radiation area"; i.e., exposures greater than 100 mR/hr. The entrance door will thus be labeled with a "Caution Radioactive Materials" sign as well as a "Caution High Radiation Area" sign. The control panel area will be posted with NRC Form 3, Summation of 10-CFR-19, as well as emergency procedures for the instance when the source remains in the "ON" position at a time when the beam should be in the "OFF" position; e.g., beam reamining "ON" or partially "ON" after preset time has expired, or an entrance interlock has been broken, or a panic shut down has been depressed, etc. The entrance into the tele-calibration area will be equipped with an electronically interlocked door to automatically return the beam from the "ON" to "OFF" position at any time the door is opened as well as forbidding the beam to be turned on while the door is opened. An independently wired continuously operating source position indicating radiation monitor will also be mounted in the room at a position of prominent visual access from the entrance doors to alert the calibration personnel of the beam's status.

Diagram #3
8th Floor Mechanics Tower Floor Layout
Showing Co-60 Source position in the Calibration Suite
(Doors have been omitted in this diagram)



Key: 4 ft. = 1 cm

In lieu of this monitor the calibration personnel will be equipped with a portable, recently calibrated survey meter for determining source status before entering the calibration high radiation area.

The teletherapy apparatus is equipped with "ON" red/ "OFF" green indicating lamps as is the control panel which coincidently indicated beam status. Indicating lamps are also positioned above the entrance door to give operators and others in the area information concerning the beam's status.

Inside the calibration high radiation area is a scram/panic button which is labeled as such and lies along the south wall at a readily accessable area near the entrance door. This scram button along with a similarly functioning and labeled panic button on the control panel permits an individual to immediately scram the beam and return the source/apparatus to its "OFF" position.

All warning lights, labels, interlocks and scram buttons will be checked semi-annually along with a sealed source leak test to assure their presence and proper functioning.

Item 15:

As described above in Item 14, the primary beam will be completely restricted for all orientations with the exception of 90^{o} horizontal towards the east wall. The tele-calibration beam will be fixed using mechanical restraints and will only be moved for realignment, replacement or radiation safety reasons.

Item 16: Shielding Evaluation

The Cobalt-60 tele-calibration irradiator is an A.E.C.L. Model Eldorado Super G human use teletherapy unit. The unit will only be used for non-human uses, principally for the calibration of customers' dosimetry systems.

There will be three major sources of radiation exposure to the adjoining areas associated with the possession and use of this Cobalt-60 source, those being:

a.) Leakage radiation
b.) Scattered radiation originating from the collimators
c.) Primary beam radiation and its associated primary beam stopper scattered radiation.

Leakage Radiation: The Cobalt-60 sealed source is designed to occupy a fixed/stationary position inside the Eldorado Super G head. "ON" beam status is achieved by opening a shutter mechanism which when opened permits the Cobalt-60 radiation to exit the head through the port and collimators. During the "ON" and "OFF" configurations the effective shielding thickness afforded by the head remains constant thus true leakage radiation emitted from the head is expected to also remain constant.

We are proposing to place a 2,200 Curie, 47.2 Rmm source into the A.E.C.L. Eldorado head, a head which is designed for a maximum head capacity of 98 Rmm. Because our proposed source strength is approximately 50% of the maximum head capacity we expect that all readings will be less than 1 mR per hour on the average and 5 mR per year maximum at one meters distance from the source.

All adjoining areas lie at a distance greater than or equal to 1.8 meters thus the highest adjoining area exposure rate due to leakage radiation is expected to be $\leq$ 0.31 mR/hr and $\leq$ 52 mR/wk assuming a 1 mR/hr at one meter exposure level, 1.80 meters distance to the areas of concern, and neglecting all attenuation afforded by wall, ceiling and floor structural materials. At this time because we lack sufficient data enabling us to precisely perdict exact leakage exposure levels we will commit ourselves to analyze very closely the exposure levels to all adjoining areas with survey meters and with monthly/or quarterly TLD area badges. We will do this in order to assure compliance with all 10-CFR-20.105 rules and regulations.

Primary Beam: It was decided that the closer the shielding material is positioned to the source(s) of Radiation the smaller the amount of shielding is necessary to render the exposure levels to surrounding adjoining areas safe. We thus choose a compact shielding design to help cope with structural weight stress problems as well as cost considerations. With this in mind the following gives the overview of the proposed shielding design for the calibration laboratory.

a. The Cobalt-60 source will be fixed at a position 4 feet from the floor with the axis of the primary beam oriented 90° horizontally towards and perpendicular to the east wall. The collimators will be adjusted to deliver a 10 cm x 10 cm radiation field at 80 cm from the Cobalt-60 source.

b. Along the collimator's length extending out towards the east wall will be positioned a lead port built to attentuate all scattered radiation produced in the propagating out from the collimators.

c. At a distance of 150 cm will be positioned a lead pot beam stopper precisely positioned to essentially attentuate the entire primary beam and resulting primary beam scattered radiation.

Collimator Scattered Radiation: The shielding design for the collimator shield uses ICRP-3 table VI (1960) and graphs derived from this table. The determined lead thickness needed to shield the scattered radiation originating from the collimators considers the scattering angles, the work load, and the distances from the collimator to each particular adjoining area of concern. Reviewing the preliminary protocols for the calibration process has led to a conservative upper limit estimate of "ON"time per week, which is expected to be no greater than 2.8 hours per week. This estimated "ON" time is based on a need of 12,600 R/week at 80 cm (8,000 R/wk at one meter). Knowing the shortest distances to each adjoining area, given the work load in R/wk at one meter, and the scattering angle allows one to perdict, using the attached graphs A and B, the thickness of lead needed to reduce the exposures to adjoining areas to levels less than 2 mR/hr.

It should be noted that the data from ICRP-3 Table VI indicate values of lead thickness needed for given work loads and distances from scattering medium to area of concern. This table was used because it represented the best available information . Table values are astericked to indicate that the published lead thickness data is for shielding scattered radiation originating from the collimators and a phantom which is exposed to a 20 cm x 20 cm field at a 50 cm source to scattered distance. In this case we are only concerned with the scatter originating from the collimators because the primar beam will not be intercepted by a phantom but rather a small dimensioned chamber. We are prepared to envelop the collimators with thickness of lead described in Table I but also feel that if calibrated portable ionization meter measurements so indicate a lesser required lead shielding thickness that we be permitted to use the empirically determined shielding design. See Table 1 of shielding estimates for scattered radiation for the collimators.

Shielding the collimators will involve placing lead or an equivalent lead thickness of another type of shielding material around the head as dictated by the results presented in Table 1. It should be noted that composition and thickness of the materials in the structured partitians (e.g., concrete in the floor) will be considered for their shielding properties. For example the 30° scattered field towards the 7th Floor below necessitates 8.52 cm of lead. 8.52 cm of lead represents 8.35 HVLs for 30° scattered Co-60 photons. The floor's linear thickness represents a little more than 2 HVLs for 30° scattered Co-60 photons. As a result the necessary lead shielding thickness to protect the area beneath the calibration suite can be lessened by 2 HVLs because of the floor's 2 HVLs equivalent concrete thickness. In practice the lead will be positioned as described above but the final thickness of lead used will be based on empirical measurements obtained using a recently calibrated ionization type survey meter for all of the adjoining areas.

Primary Beam Stop: The primary beam stop is constructed in the formation of a cave. The primary beam stop or Pot is shown in Diagram 4. It is made up of two sections, the cavity section and the beam stop section. The cavity section measures 40 cm in length along the axis of the primary beam and is designed such that the deverging primary field never strikes any of the cavity's walls (see Diagram 5). The primary beam will be first intercepted by the solid section of the primary beam stop. This beam stop measures 25 cm thick, 25 cm tall and 30 - 40 cm wide. The primary beam exposure level transmitting through the beam stop will be 0.5 mR/hr on contact with the existing side of the primary beam stop by virtue of the beam stops approximately 21 HVL thickness.

Exposures to the adjoining areas due to scattered radiation originating from the beam stopper are calculated to be ALARA. Table 2 summarizes the data involved in calculating the expected exposure levels in adjoining areas. What follows is Table 2 and the description of how the values in Table 2 were derived.

TABLE 1

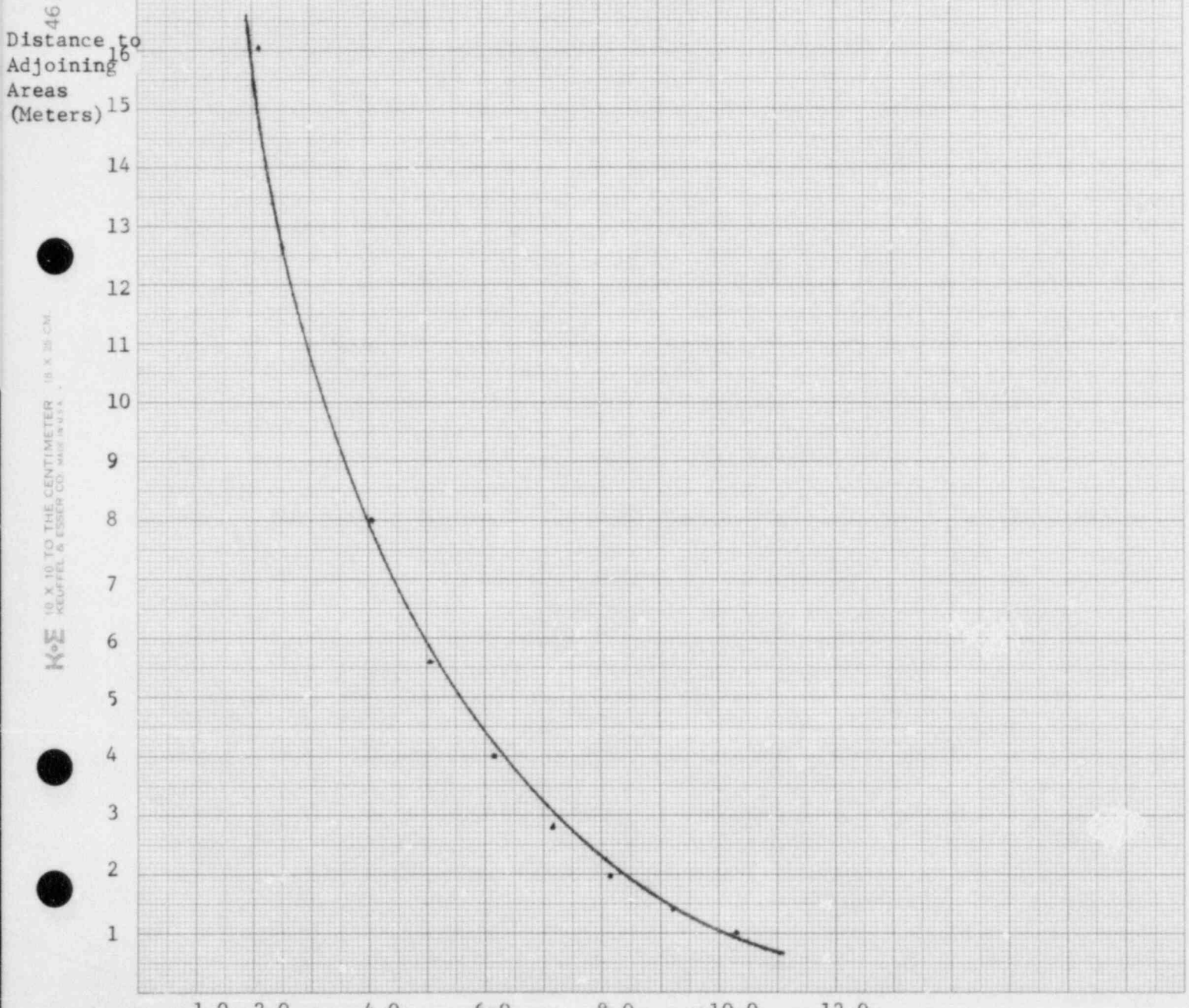
Shielding Estimates For Scatter Radiation from Collimators

Adjoining Area of Concern	Shortest Distance from Collimators to Area of Concern for Given Scattering Angle	Scattering Angle	*Thickness of Lead needed to reduce scattered exposure to 5 mR/wk and 2 mR/hr.
Ceiling/Roof Top	3.58 m	90°	3.02 cm
7th Floor Below 7 ft. height	3.33 m	90°	3.12 cm
South Wall Storage Room	1.83 m	90°	3.85 cm
West Wall Conference Room	N/A	N/A	N/A
East Wall Primary Wall	N/A	N/A	N/A
North Wall Unoccupied Area	1.64 m	90°	3.97 cm
Ceiling	5.97 m	30°	9.08 cm
7th Floor Below	6.94 m	30°	8.65 cm
South Wall	3.29 m	30°	10.74 cm
North Wall	3.72 m	30°	10.41 cm
West Wall	2.84 m	150°	0.90 cm
South Wall	2.62 m	60°	7.15 cm

*Calculated from Graphs A or B value + 1 TVL + 1HVL = x cm Pb to give 5 mR/wk. and 1.8 mR/hr
Graph A or B (value) x (0.95) to get 8,000 R/wk value from a 10,000 R/wk graph.

GRAPH A

Extracted from ICRP-3 (1960) Table VI
for a.) workload
10,000 R/wk at 1 m
b.) Scatter Angle
30°



GRAPH B

Extracted from ICRP-3 (1960)Table VI
for a.) workload
10,000 R/wk at 1 m
b.) Scatter Angle
90°

461510

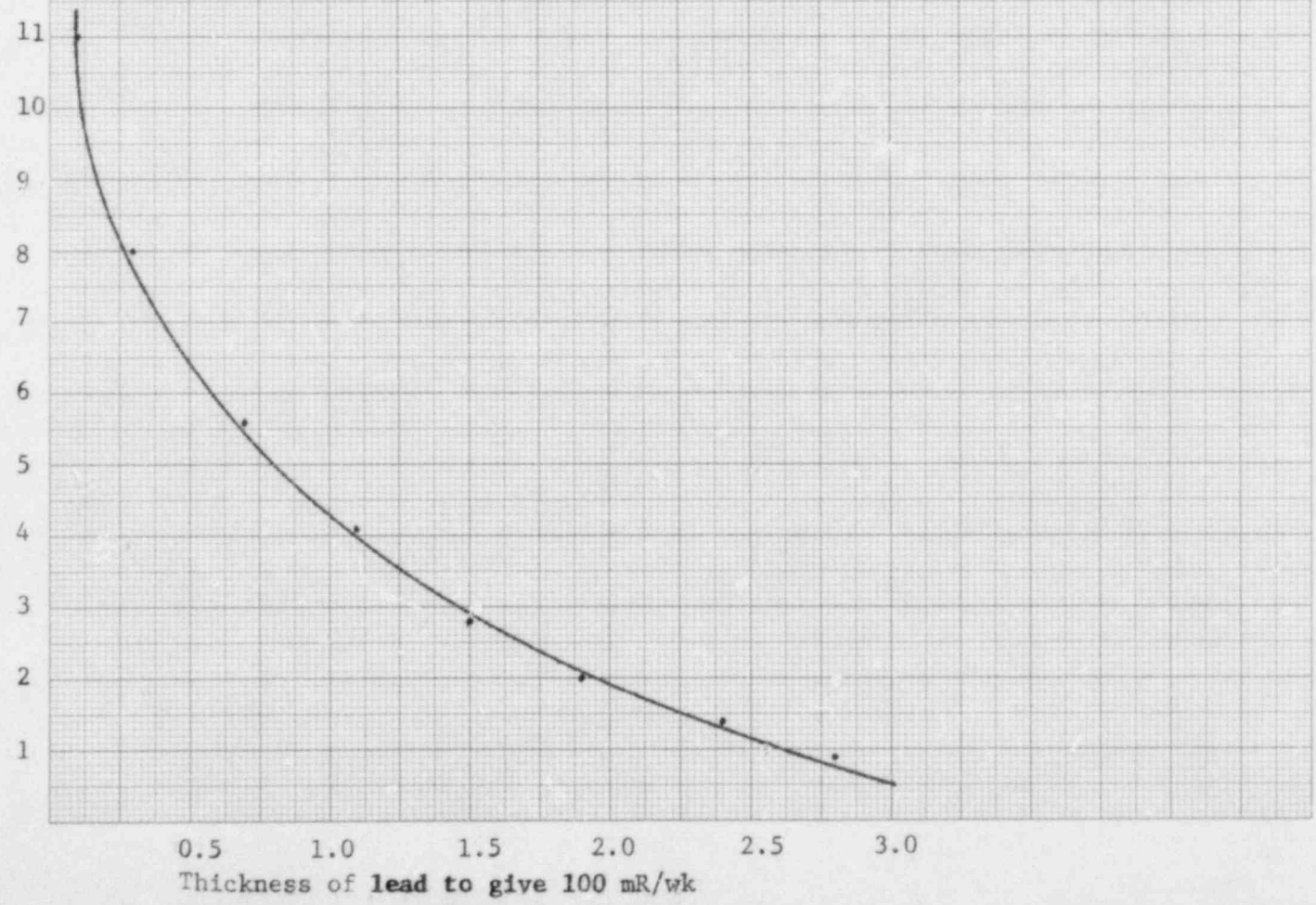


Table 2
Shielding Estimates for Primary Beam Stopper

Adjoining Area	Scattering Angle	Unattenuated Exposure Level @ 1m	Effective Lead Thickness	TVL	Transmission Factor Through Lead Pot	Expected Exposure Levels dsca.	mR/Hr.	mR/wk.	mR/quarter	mR/yr.
West Wall	150°	514.8 mR/hr	1 cm	0.45 cm	0.006	4.17m	0.18	0.50	6.5	26
South Wall	150°	514.8 mR/hr	1 cm	0.45 cm	0.006	3.54m	0.25	0.69	9.0	36
Roof	150°	514.8 mR/hr	1 cm	0.45 cm	0.006	4.57m	0.15	0.41	5.3	21
7th Floor										
a.) (min)	150°	514.8 mR/hr	1 cm	0.45 cm	0.006	2.50m	0.49	1.38	17.9	72
b.) 7 ft.	150°	514.8 mR/hr	1 cm	0.45 cm	0.006	6.34m	0.08	0.22	3.0	11
North Wall	60°	2,049.3 mR/hr	7.8 cm	2.5 cm	7.6×10^{-4}	2.33m	0.31	0.87	11.3	45
South Wall	60°	2,049.3 mR/hr	7.8 cm	2.5 cm	7.6×10^{-4}	2.61m	0.23	0.64	8.3	33
Roof	60°	2,049.3 mR/hr	7.8 cm	2.5 cm	7.6×10^{-4}	4.27m	0.09	0.25	3.3	13
7th Floor										
a.) (min)	60°	2,049.3 mR/hr	7.8 cm	2.5 cm	7.6×10^{-4}	1.43m	0.76	2.13	27.7	111
b.) 7 ft.	60°	2,049.3 mR/hr	7.8 cm	2.5 cm	7.6×10^{-4}	3.54m	0.13	0.36	4.7	19
North Wall	90°	801.9 mR/hr	5 cm	1.45 cm	3.6×10^{-4}	1.64m	0.11	0.31	4.0	16
South Wall	90°	801.9 mR/hr	5 cm	1.45 cm	3.6×10^{-4}	1.86m	0.08	0.22	2.9	11
Roof	90°	801.9 mR/hr	5 cm	1.45 cm	3.6×10^{-4}	3.72m	0.02	0.06	0.7	3
7th Floor										
a.) (min)	90°	801.9 mR/hr	5 cm	1.45 cm	3.6×10^{-4}	1.34m	0.16	0.45	5.8	23
b.) 7 ft.	90°	801.9 mR/hr	5 cm	1.45 cm	3.6×10^{-4}	3.05m	0.03	0.08	1.1	4
North Wall	30°	5,362 mR/hr	12.9 cm	3.4 cm	1.6×10^{-4}	3.72m	0.09	0.25	3.3	13
South Wall	30°	5,362 mR/hr	12.9 cm	3.4 cm	1.6×10^{-4}	3.29m	0.11	0.31	4.0	16
Roof	30°	5,362 mR/hr	12.9 cm	3.4 cm	1.6×10^{-4}	7.62m	0.02	0.06	0.7	3
7th Floor										
a.) (min)	30°	5,362 mR/hr	12.9 cm	3.4 cm	1.6×10^{-4}	2.47m	0.03	0.08	1.1	4
b.) 7 ft.	30°	5,362 mR/hr	12.9 cm	3.4 cm	1.6×10^{-4}	6.22m	0.20	0.56	7.3	29
East Wall	Primary	*9.918×10^{5} mR/hr	25 cm	4 cm	5.6×10^{-7}	*0 m	0.56	1.56	20	81

*Exit side of Beam Stopper.

Explanation of Table 2 Values

• The "unattentuated exposure level at 1 meter" values in Table 2 were calculated as follows:

$$R_{xo} = (R_o) \cdot (a_{xo}) \cdot (F)$$

where; R_{xo} = unattenuated exposure level at 1 meter from scattering angle x^o

R_o = incident exposure on entrance surface of beam stopper

a_{xo} = scatter ratio for scattering angle x^o [1]

F = Field size correction or field size at beam stopper surface divided by 400 cm^2 or $\frac{16.25 \text{ cm} \times 16.25 \text{ cm}}{400 \text{ cm}^2} = 0.66 = F$.

• The effective lead thickness were determined from Diagram 6, and represent the minimum effective lead thickness afforded by the beam stopper.

• TVL were extracted from ICRP-3 (1960) Table VI.

• Transmission factors through lead pot were calculated by determining the minimum number of TVLs afforded by the beam stopper for each scattering angle.

• dsca is the shortest distance from the beam stopper to the adjoining area of concern for each scattering angle. These values were determined from Diagrams 6 and 7.

• mR/hr values were determined using the following equation:

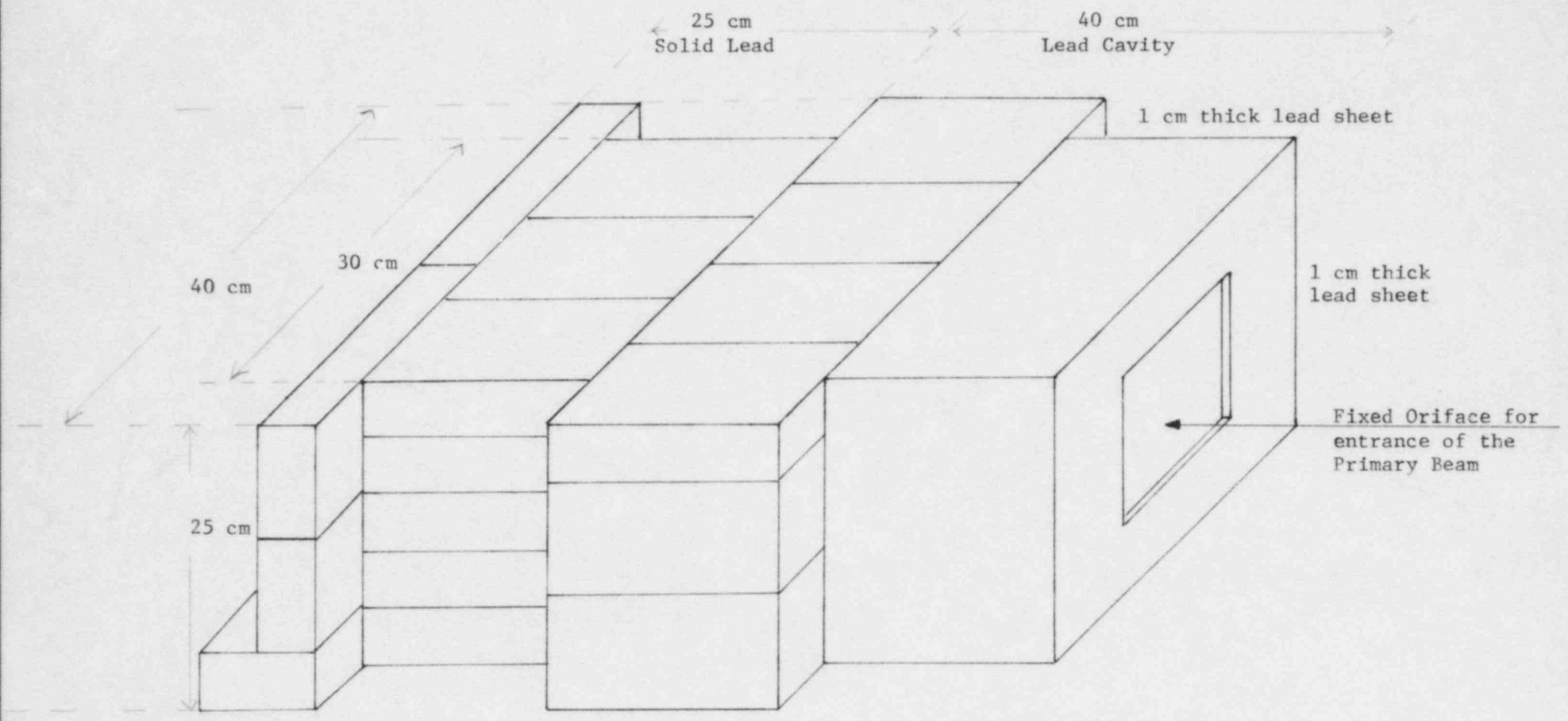
$$\text{mR/hr} = R_{xo} \times \text{trans. factor} \times \frac{1}{(\text{dsca})^2}$$

• mR/wk values were determined by multiplying mR/hr values by "ON" time per week or ; mR/wk = mR/hr x 2.8 hr/wk

• mR/quarter and mR/yr values were determined by multiplying mR/wk values by (x13) and (x52) respectively.

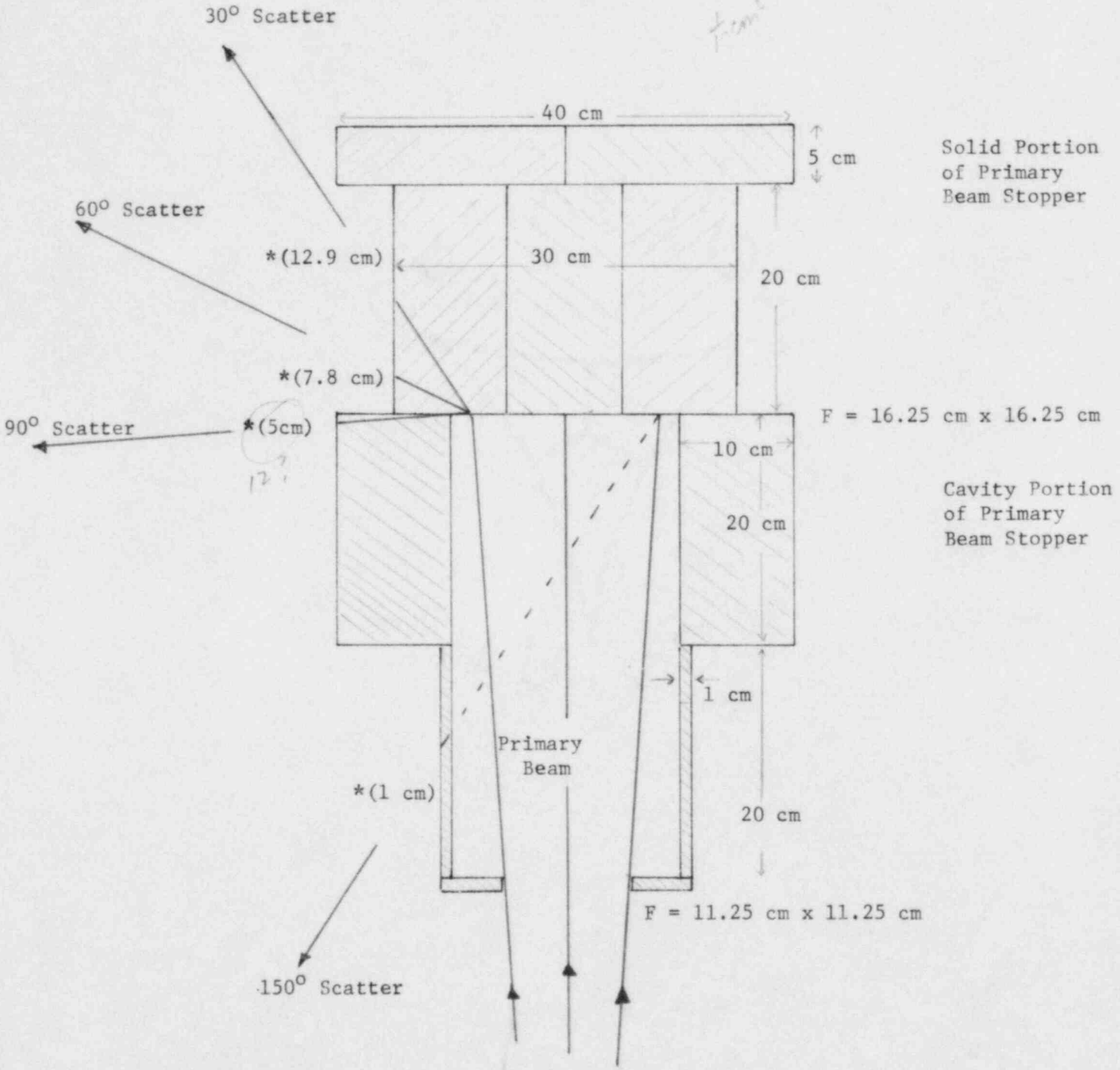
[1] NCRP 49, 1976, Table B-2, Page 59

Diagram 4:



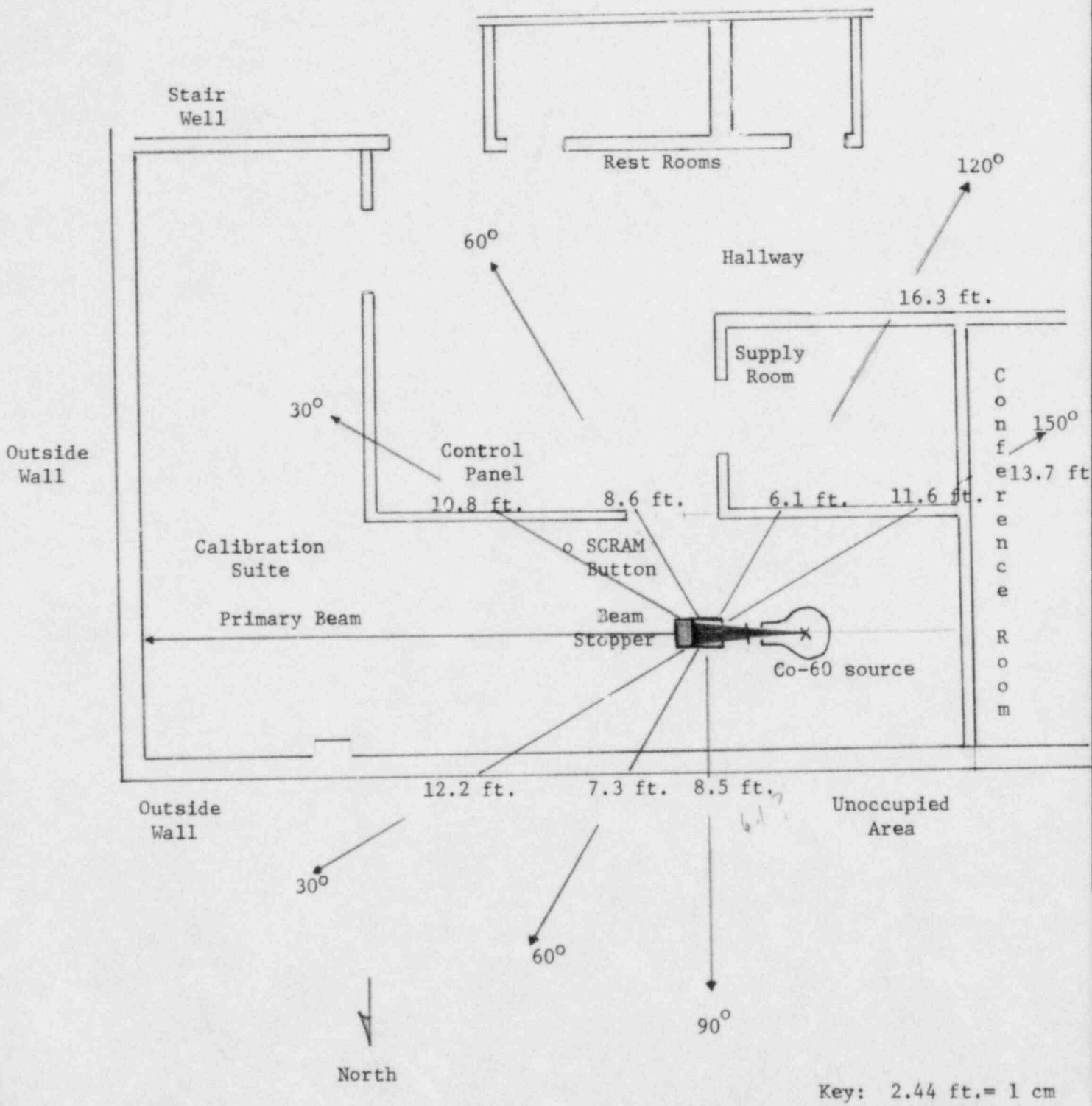
3 Dimensional View of
Primary Beam Stopper

Diagram 5:
Horizontal Cross Sectional View
of Primary Beam Stopper & Pot



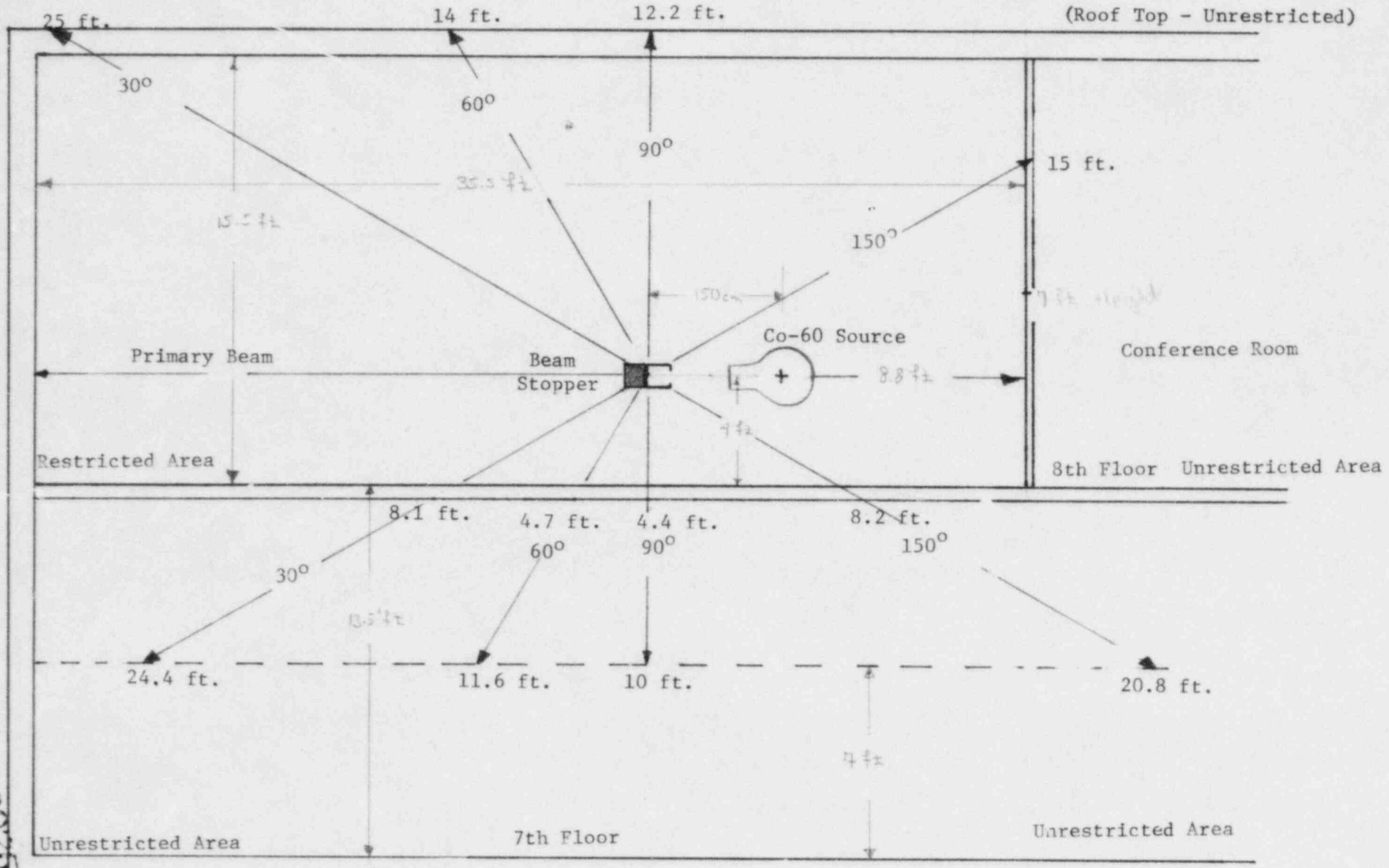
*Minimum lead thickness for
associated scattering angle.

Diagram 6:
Top or Horizontal Veiw
Distance from Beam Stopper
to adjoining areas for scattering
Angle 30°, 60°, 90°, 120° & 150°



Key: 2.44 ft.= 1 cm

Diagram 7: Side or Vertical View
Distance from Beam Stopper
to adjoining areas for scattering
angles 30°, 60°, 90° & 150°



Key: 0.5 cm = 1 ft.

Concluding Remarks:

In the above discussion the estimated shielding thickness and resulting estimated adjoining areas exposure levels have been addressed. It is felt that all shielding estimates are based on conservative assumptions thus the adjoining area exposure levels are considered upper limit estimates. Items not addressed above would be the potential scattered exposure field originating from a chamber which is placed into the field and large angle ($180^{o} \pm 10^{o}$) backscatter exposure fields which will be emitted from the Primary Beam stopper's fixed oriface.

The exposure fields originating from a chamber positioned in the 75 Rm 80 cm field aren't expected to be of major concern by virtue of the chamber-chamber stem's small dimensions. We will be most certain to systematically obtain exposure measurement values for all adjoining areas before the calibration service goes operational. If the levels warrant additional shielding we would design more shielding, test the design using a systematic approach until such time that the Radiation Safety Office is satisfied that compliance with 10-CFR-20.105 is achieved.

The case of backscattered radiation fields propagating out through the oriface has been determined that the effective energy of this radiation will be less than 220 KeV, will be produced with a low probability, i.e., small scattering ratio and thus should be easily shielded with thin sheets or panels of lead.

Again in this case of uncontained backscatter if initial measurements show the need for additional shielding this shielding will be employed prior to permitting the calibration facility to go operational.

In any event an evaluation survey will be conducted on the safety and safeguards system and the exposure levels to all adjoining areas. Also, an array of area TLD monitors will be strategically placed in critical adjoining areas where the potential for radiation exposure is the greatest. Analysis of the data, decision making and any needed remedial measures will be based on ALARA concepts. Once approved the source will be installed, the systematic safety survey will be conducted and a report of the survey results will be forwarded to the NRC within 30 days of the installation. Records of all surveys, area badge records, and "On" time analysis will be kept and forwarded to the Radiation Safety Office for review by future NRC inspectors.

Finally the exact positioning of the primary beam stopper and fixed oriface will be achieved using the Eldorado Super G's light field. A light field - radiation field congruency test will be used to verify that the light field is trustworthy. Any servicing involving the Co-60 source or removing inherent lead shielding, i.e., collimators or port,will be performed by a qualified (certified) Co-60 teletherapy service representative.

NRC Form 782
(1-82)

U.S. NUCLEAR REGULATORY COMMISSION

NOV 3 1983

MATERIALS DATA INPUT – INDUSTRIAL, MEDICAL, SOURCE/SPECIAL NUCLEAR

A. TYPE OF ACTION AND IDENTIFICATION CODES

	NEW LICENSE		AMENDMENT TO RENEW LICENSE		AMENDMENT TO TERMINATE	X	VOID	DOCKET NUMBER	MAIL CONTROL NUMBER	CHANGE NAME/ADDRESS ("X" box)
1	NEW LICENSE AND NEW LICENSEE	XX	OTHER AMENDMENT		CLERICAL CHANGE NO AMENDMENT	4		030-00462	16075	XX

B. INDICATIVE INFORMATION

INDIVIDUAL LICENSEES	NAME (Last, First, Middle)	NAME (Last, First, Middle)
	NAME (Last, First, Middle)	NAME (Last, First, Middle)
	NAME (Last, First, Middle)	NAME (Last, First, Middle)
ORGANIZATION 3 LICENSEES	ORGANIZATION NAME (Alphabetic Sequence) Allegheny Health, Education and Research Corp.	
	DEPARTMENT OR BUREAU	
ADDRESS 5	BUILDING, STREET 320 East North Avenue	CITY Pittsburgh / STATE PA / ZIP CODE 15212

6	TYPE APPLICANT		DATE REQUEST RECEIVED	INSTITUTION CODE	PENDING PROG. CODE	ACTUAL PROG. CODE
	033	U.S. GOVERNMENT AGENCY INDIVIDUAL LICENSEE ORGANIZATIONAL LICENSEE	10/21/83	1317		

SECONDARY PROGRAM CODES (As required)

#1	#2	#3	#4	#5

7	LICENSE NUMBER	DATE LICENSE ISSUED OR ACTION COMPLETED	EXPIRATION DATE
	37-01317-02	MAR 27 1985	

C. STATISTICAL INFORMATION

MEDICAL CATEGORY		FOR HUMAN USE ONLY		FOR HUMAN AND NONHUMAN USE		FOR NONHUMAN USE ONLY

POSSESSION OF THE MATERIAL IS AUTHORIZED IN ONE OF THE FOLLOWING AREAS

AND/OR IN THE STATE(S), TERRITORY(IES), COUNTRY CHECKED (At right)

	SAME AS "STATE" IN ADDRESS		ALL STATES		ALL NON-AGREEMENT STATES	
	AL - ALABAMA	GA - GEORGIA	MD - MARYLAND	NJ - NEW JERSEY	SC - SOUTH CAROLINA	WY - WYOMING
	AK - ALASKA	HI - HAWAII	MA - MASSACHUSETTS	NM - NEW MEXICO	SD - SOUTH DAKOTA	
	AZ - ARIZONA	ID - IDAHO	MI - MICHIGAN	NY - NEW YORK	TN - TENNESSEE	AS - AMERICAN SOMOA
	AR - ARKANSAS	IL - ILLINOIS	MN - MINNESOTA	NC - NORTH CAROLINA	TX - TEXAS	CZ - CANAL ZONE
	CA - CALIFORNIA	IN - INDIANA	MS - MISSISSIPPI	ND - NORTH DAKOTA	UT - UTAH	GU - GUAM
	CO - COLORADO	IA - IOWA	MO - MISSOURI	OH - OHIO	VT - VERMONT	PR - PUERTO RICO
	CT - CONNECTICUT	KS - KANSAS	MT - MONTANA	OK - OKLAHOMA	VA - VIRGINIA	VI - VIRGIN ISLANDS
	DE - DELAWARE	KY - KENTUCKY	NB - NEBRASKA	OR - OREGON	WA - WASHINGTON	
	DC - WASHINGTON, DC	LA - LOUISIANA	NV - NEVADA	PA - PENNSYLVANIA	WV - WEST VIRGINIA	CN - CANADA
	FL - FLORIDA	ME - MAINE	NH - NEW HAMPSHIRE	RI - RHODE ISLAND	WI - WISCONSIN	

D. POSSESSION LIMITS OF SOURCE AND SPECIAL NUCLEAR MATERIALS AND TRITIUM

SOURCE MATERIAL CEILING	G - GRAMS Kg - KILOGRAMS	SNM CEILING	G - GRAMS Kg - KILOGRAMS	IF FOR POWER REACTOR ("X" here)

*MATERIAL	AMOUNT	UNIT	CONFIG	ENRICH	*MATERIAL	AMOUNT	UNIT	CONFIG	ENRICH
35 - U235		G / Kg	S / UNS				G / Kg	S / UNS	
33 - U233		G / Kg	S / UNS				G / Kg	S / UNS	
PU - Plutonium		G / Kg	S / UNS				G / Kg	S / UNS	
UR - Uranium		G / Kg	S / UNS				G / Kg	S / UNS	
TH - Thorium		G / Kg	S / UNS				G / Kg	S / UNS	
		G / Kg	S / UNS				G / Kg	S / UNS	
		G / Kg	S / UNS				G / Kg	S / UNS	
H3 - Tritium		CURIES / MILLICURIES / MICROCURIES			RIS CODES				

*Use two digit codes. S - SEALED UNS - UNSEALED

NRC Form 782
(1-82)

1 – FILE COPY