NORTHWEST RADIATION ONCOLOGY

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July 15, 1986

Radioisotope Licensing Branch
USNRC - Region III
799 Roosevelt Road
Glen Elyn, Illinois

RE: Amendment to NRC License No. 24-24331-01

To Whom It May Concern:

We would like to amend our teletherapy license as follows:

Add Lily Ann Hanes, M.D. as an authorized user. Dr. Hanes was previously named on our license.

Move the Picker Co-60 unit to a new location within the current room. See the supporting documentation for details.

Please find enclosed a check in the amount of $230.00 as specified in CFR part 170.31 category 7A.

Sincerely,

David J. Keys, Ph.D.

David J. Keys, Ph.D.
Radiation Safety Officer

DJK:sjk

'86 JUL 25 A10:12

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Log
Remitted July 26
Check No. 3405
Amount $230
Fee Category 7A
Type of Fee Amd
Date Check Rec'd.
Date Completed 7/25/86
By: gb

8702040541 861022
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CONTROL NO. 81741

NORTHWEST RADIATION ONCOLOGY
CO-60 SHIELDING CALCULATIONS

Comment: Please see the accompanying drawing depicting the Co-60 Rx room. This room originally was designed to house a 20 MV linear accelerator. All walls unless otherwise specified are built of concrete.

Assumptions: The following assumptions apply to our calculations:
Workload - 40000 R/wk at one meter (as recommended by NCRP Report 49, page 64)
Max. Source Strength - 9000 RHM (max allowed by the manufacturer)
Max. Field Size - 40 x 40 @ 80 cm
Concrete Density - 147 lbs/ft^3

Definitions:

d_{pri} = distance from the source to the point of interest

d_s = distance from the scatterer to the point of interest

d_1 = d_{pri}

SSD = source to surface distance

t_c = thickness of concrete (cm)

T_x = transmission through the shielding; this value is determined from NCRP 49, page 102 or alternatively, by using a TVL of 20.6 cm of concrete

$\dot{R}$ = exposure rate in mR/hr

$\dot{R}_w$ = weekly exposure in mR/hr

a = ratio of the primary to scattered component within a patient

w = workload

RHM = roentgen per hour at 1 meter

A = area of max field size = 1600 cm^2

L = leakage radiation = 0.1% of RHM

Allowed Beam Directions:
30° in, 90° out
30° CW, 30° CCW

Primary Walls: Walls along pts. B and C

Equations:

Primary Radiation

$$\dot{R} = RHM/(d_{pri})^2 \times T_x \times 1000 \text{ mR/R}$$

$$\dot{R}_w = w/(d_{pri})^2 \times T_x \times 2000 \text{ mR/R} = \dot{R} \text{ w/RHM}$$

Scattered Radiation

$$\dot{R} = RHM/(SSD)^2 \times a \times 1/(d_s)^2 \times T_x \times 1600/400 \times 1000 \text{ mR/R}$$

$$\dot{R}_w = \dot{R} \text{ w/RHM}$$

Leakage Radiation

$$\dot{R} = RHM/(d_l)^2 \times L \times T_x \times 1000 \text{ mR/R}$$

$$\dot{R}_w = \dot{R} \text{ w/RHM}$$

LOCATION A - PHYSICS OFFICE

d_s = 7.7 m

t_c = 0.76 m

T_x = 2.0×10^{-4}

Scatter

$\dot{R}$ = $9000/(0.8)^2 \times 0.001 \times 1/(7.7)^2 \times 2.0 \times 10^{-4} \times 1600/400 \times 1000$ mR/R

= 0.19 mR/hr

$\dot{R}_W$ = 0.19 x 40000/9000 = 0.84 mR/wk

Leakage

$\dot{R}$ = $9000/(7.7)^2 \times 0.001 \times 2.0 \times 10^{-4} \times 1000$ mR/R

= 0.03 mR/hr

$\dot{R}_W$ = 0.03 x 40000/9000 = 0.13 mR/wk

Net $\dot{R}$ = 0.19 + 0.03 = 0.22 mR/hr

Net $\dot{R}_W$ = 0.84 + 0.13 = 0.97 mR/wk

LOCATION B - CONSOLE AREA - CONTROLLED AREA

d_{pri} = 7.32 m

t_c = 122 cm

T_x = 3×10^{-6}

$\dot{R}$ = $9000/(7.32)^2 \times 3 \times 10^{-6} \times 1000$ mR/R = 0.5 mR/hr

$\dot{R}_W$ = 2.0 x 40000/9000 = 2.2 mR/wk

Because primary dominates scatter or leakage components by about 3 orders of magnitude, no scatter or leakage calculations are necessary.

LOCATION C - CLINAC 6 AREA

d_{pri} = 6.7 m

t_c = 6^1 = 1.83 m

T_x = 8.88 TVL = 1.32×10^{-9}

$\dot{R}$ = $9000/(6.7)^2 \times 1.32 \times 10^{-9} \times 1000$ mR/R

= 0.0 mR/hr

$\dot{R}_W$ = 0.0 mR/wk

LOCATION D - PARKING LOT

No primary beam will be allowed. The primary beam is restricted via an electrical interlock which will limit motion to 30° CCW from vertical down. CW is defined viewing the unit from in front of the stand.

d_s = 3.0 m

SSD = 0.8 m

a = 0.001

t_c = 0.91 m

T_x = 2.2×10^{-5}

Scatter

$\dot{R}$ = $9000/(0.8)^2 \times 0.001 \times 1/(3.0)^2 \times 2.2 \times 10^{-5} \times 1600/400 \times 1000$ mR/R

= 0.13 mR/hr

$\dot{R}_w$ = 36.13 x 40000/9000 = 0.6 mR/wk

Leakage

$\dot{R}$ = $9000/(3.0)^2 \times 0.001 \times 2.2 \times 10^{-5} \times 1000$ mR/R

= 0.02 mR/hr

Net $\dot{R}$ = 0.13 + 0.02 = 0.15 mR/hr

Net $\dot{R}_w$ = 0.6 + 0.1 = 0.7 mR/wk

LOCATION E - OUTSIDE WALL

d_s = 3.0 m

t_c = 1.22 m

Since this wall has the same distances as point E, but substantially thicker walls, there will be less radiation than for point D.

LOCATION F - CLINAC 6/100 ROOM, BACK CORNER

d_s = 6.1 m

t_c = 0.91 m

Since the distances are much greater than for location D, the exposure rates will be much less.

LOCATION - UNDER CO-60 ROOM

Comment: There is ground under the unit; therefore, there is no occupancy, no exposure.

LOCATION - ROOM ABOVE THE CO-60 UNIT

Comment: Directly above the unit the thickness is equivalent to greater than 4 feet of concrete. Off center from the unit the thickness is a minimum of 3 feet thick. No primary is allowed due to mechanical limitations (90^{o} out - max) and electrical (90 CW from vertical down - max)

SSD = 0.8 m

d_s = 3.05 m

d_l = 2.25 m

a = 0.001

t_c = 91.4 cm

T_x = 4.5×10^{-5}

Scatter

$\dot{R} = 9000/(0.8)^2 \times 0.001 \times 1/(3.05)^2 \times 4.5 \times 10^{-5} \times 1600/400 \times 1000$ mR/R

$= 0.27$ mR/hr

$\dot{R}_w = 0.27 \times 40000/9000 = 1.21$ mR/wk

Leakage

$\dot{R} = 9000/(2.25)^2 \times 0.001 \times 4.5 \times 10^{-5} \times 1000$ mR/R

$= 0.08$ mR/hr

$\dot{R}_w = 0.35$ mR/wk

Total $\dot{R} = 0.27 + 0.08 = 0.35$ mR/hr

$\dot{R}_w = 1.21 + 0.35 = 1.56$ mR/wk

Summary

Calculations have been made which show that, using the beam limitations requested (30 CW, -30 CCW from vertical down; 90° out, 30° in), there will be no unrestricted areas where exposure rates of greater than 2.0 mR/hr or 100 mR in a week can occur. In addition we are assured because of the low weekly exposures that no one in the area surrounding the Co-60 unit, even if continually present, will receive 500 mR in one years time.

Note: Because of the shielding involved, it is not necessary to calculate the added weekly exposure due to 2 mR/hr leakage at 1 meter with the beam in the OFF position.

David J. Keys, Ph.D.

David J. Keys, Ph.D.
7/14/86

DJK:sjk

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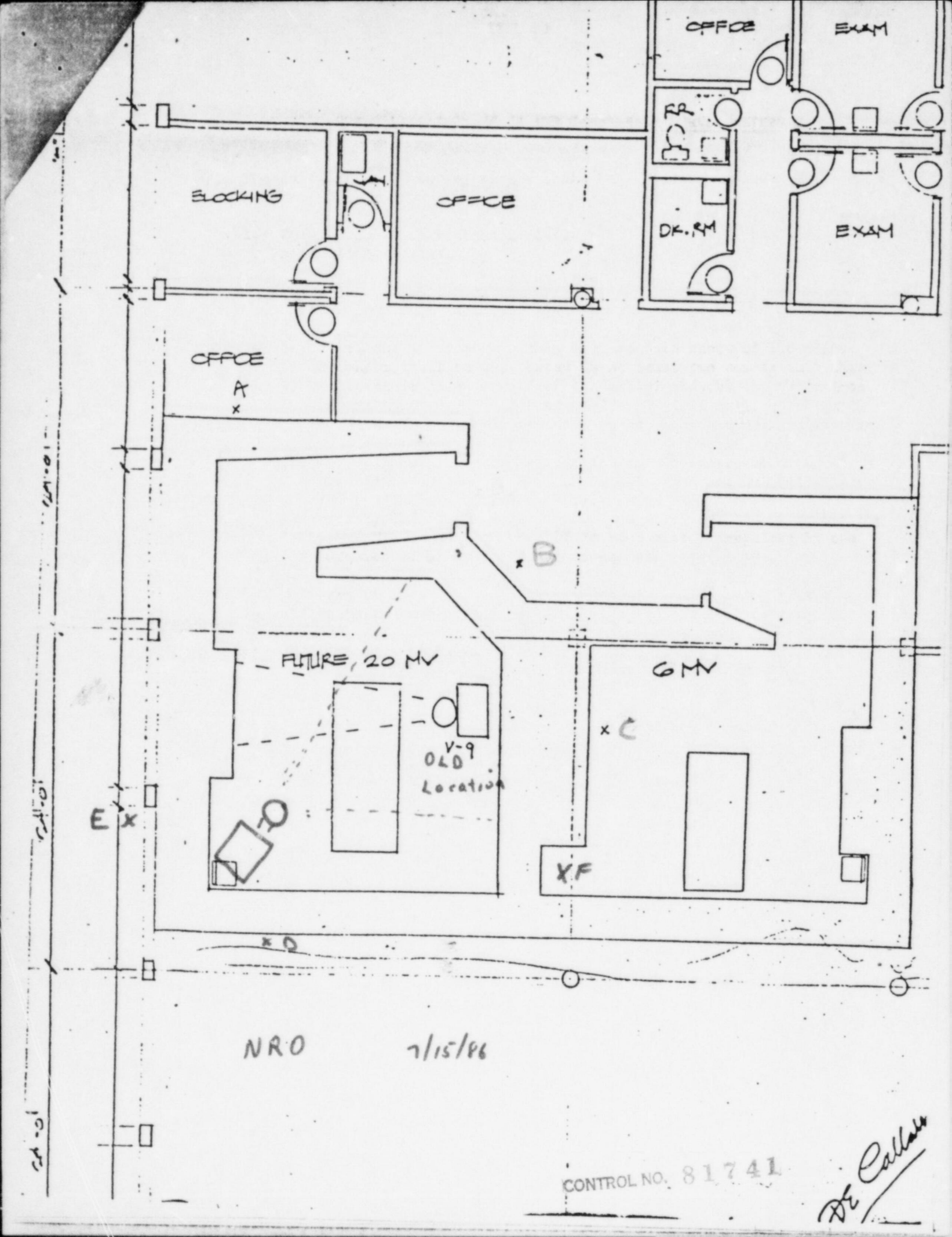

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