# IOWA METHODIST HOSPITAL

RAYMOND BLANK MEMORIAL HOSPITAL FOR CHILDREN
YOUNKER MEMORIAL REHABILITATION CENTER
HELEN POWELL CONVALESCENT CENTER

Area Code: 515
Telephone: 283-6212

1200 PLEASANT STREET
DES MOINES, IOWA 50308


4923

December 5, 1974

5/891

Mr. Frank C. Davis
Material Branch
Directorate of Licensing
Atomic Energy Commission
Washington D.C. 20545

Dear Mr. Davis:

I am writing in response to your letter of October 29, 1974 for additional information for a cobalt-60 tele-therapy license.

Attached to this letter is a copy of the calculations requested performed by our radiation physicist, Mr. Steven Babcock.

If additional information is necessary, please contact me.

Yours truly,

David S. Ramsey
Vice President & Administrator

DSR:rh

Enc.

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*Department of Radiology*
*Area Code 515 283-6171*

4929

December 4, 1974

Enclosed is the extra information you requested. Your letter is enclosed.

The original shielding calculations could not be found. What has been done is a set of shielding calculations using NCRP No. 34 to show that the shielding is adequate. However, before the room is put into use a radiation survey will be done, to insure safe radiation levels in the adjacent areas.

The TV viewing system will be backed up by an alternate viewing system. The back-up shall consist of a lead window in the door and a curved mirror in the northwest corner of the room. With this, viewing of the patient can be maintained.

Steven M. Babcock

Steven M. Babcock,
Medical Physicist.

NCRP Report No. 34 - Medical X-ray and Gamma Ray Protection for energies up to 10 MEV - Structural Shielding Design and Evaluation - was used to find the required shielding. In particular, information in Appendices B, C and D was used.

The following values were used in the calculations.

W = 40,000 R/week at 1 meter
U = 1
T = 1 except for ceiling T = 1/16

The equations used were:

For scattered radiation

$$B_{sg} = \frac{P}{aWT} (d_{sec})^2 (d_{scat})^2$$

a - from Table B-2 NCRP 34

For leakage radiation

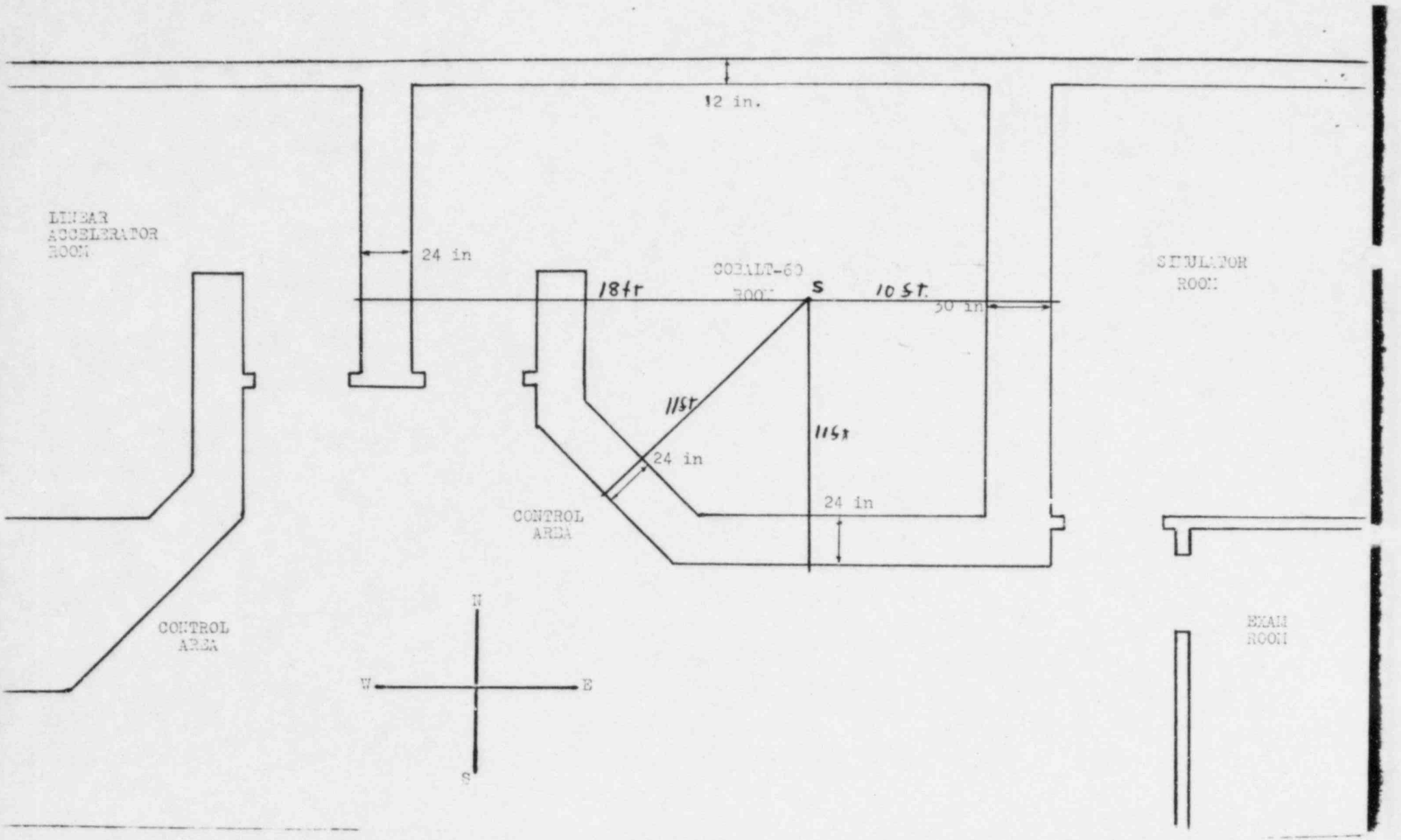
$$B_{Lg} = \frac{1000 P (d_{sec})^2}{WT}$$

or

$$B_{Lg} = \frac{P (d_{sec})^2}{40}$$

S in the figure is the source location. Shielding calculations need only to be done along the four radii to walls in the figure plus to the ceiling. This being because the machine can only point at the floor on the north wall and these regions are unexcavated non-accessible areas for which shielding calculations need not be done. The radiation to walls under consideration is scattered or leakage. The area above the room is a non-controlled area; the rest are controlled areas. The distance to the south wall and to the control area is the same, hence their calculations are the same.

The door to the room is specified as having 1/4 inch lead lining. The lead glass window will have 1/4 inch lead equivalent.


12 in.
LINEAR ACCELERATOR ROOM
24 in
18ft
COBALT-60
S
10 ft.
30 in
SIMULATOR ROOM
11ft
11ft
24 in
24 in
CONTROL AREA
CONTROL AREA
N
W
E
S
EXAM ROOM

South wall - Control area

$d_{sec} = 11 ft. = 3.35 m \qquad d_{scat} = .8 m$

Scattered

$$B_{sg} = \frac{(.1)(3.35)^2(.8)^2}{40\,a} = \frac{1.79 \times 10^{-2}}{a}$$

$B_{sg}$ for 30° $= 2.99 \times 10^{-3} \Rightarrow$ 22 in concrete

* $B_{sg}$ for 90° $= 2 \times 10^{-2} \Rightarrow$ 10 in concrete

$B_{sg}$ for 135° $= 2.99 \times 10^{-2} \Rightarrow$ 7 in concrete

Leakage

$$B_{Lg} = \frac{.1(3.35)^2}{40} = 2.8 \times 10^{-2} \Rightarrow 14.5$$

The calculations require 17 inches of concrete. The wall has 24 inches

* 90° scatter main contribution - shielding based on this

West Wall

$d_{sec} = 18\,ft = 5.5\,m$
$d_{coat} = .8\,m$

scattered

$$B_{sg} = \frac{(.1)(5.5)^2(.8)^2}{40} = \frac{4.84\times10^{-2}}{a}$$

$B_{sg}$ for $15° = 8\times10^{-3} \Rightarrow$ 18 in concrete

* $B_{sg}$ for $90° = 5.38\times10^{-2} \Rightarrow$ 8 in concrete

$B_{sg}$ for $135° = 8\times10^{-2} \Rightarrow$ 6 in concrete

leakage

$$B_{Lg} = \frac{.1(5.5)^2}{40} = 7.56\times10^{-2} \Rightarrow 18 \text{ in concrete}$$

The calculations require 18 inches of concrete. The wall has 24 inches

* 90° scatter main contribution - sheilding based on this

East Wall

$d_{sec} = 10 \text{ feet} = 3.05 \text{ m}$
$d_{sca} = .8 \text{ m}$

Scattered

$$B_{sg} = \frac{.1(3.05)^2(.8)^2}{40\ a} = \frac{1.49 \times 10^{-2}}{a}$$

$B_{sg}$ for $30^\circ = 2.48 \times 10^{-3} \Rightarrow$ 22 in concrete

* $B_{sg}$ for $90^\circ = 1.65 \times 10^{-2} \Rightarrow$ 12 in concrete

$B_{sg}$ for $135^\circ = 2.48 \times 10^{-2} \Rightarrow$ 9 in concrete

Leakage

$$B_{Lg} = \frac{.1(3.05)^2}{40} = 2.32 \times 10^{-2} \Rightarrow 15 \text{ in concrete}$$

The calculations require 18 inches of concrete. The wall has 30 inches.

* 90° scatter main contribution - shielding based on this.

Ceiling

The ceiling height is 9 feet and then there is 36 inches of concrete. The total distance to the room above is 13 feet or 3.66 meters. The source would be at most 2 meters off the floor. Thus dsec is 1.66 meters. $d_{scat} = .8m$

Leakage

$$B_{Lg} = \frac{(1000)(.01)(1.66)^2}{40{,}000 \times \frac{1}{16}} = 1.1 \times 10^{-2} \Rightarrow 18 \text{ in concrete}$$

Scattered

$$B_{sg} = \frac{.01(.8)^2(1.66)^2}{40\,a} = \frac{4.4 \times 10^{-4}}{a}$$

* $B_{sg}$ for $135^\circ = 7.3 \times 10^{-4} \Rightarrow$ 18 in concrete

The calculations require 27 inches of concrete. The ceiling has 36 inches

* 135° scatter only that reach it. for need back scattered radiation to hit ceiling.