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August 9, 1984

Patricia J. Whiston
Materials Licensing Section
U. S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Subject: Control Number 76930

Dear Ms. Whiston:

In answer to the questions posed by your most recent letter and from the discussion held this morning the following information is submitted.

Beam Stops: The beam stops are mechanical. They will adjusted to stop the beam from coming to the on position whenever the beam exceeds 90 degrees to the east and west, or the beam will operate without the beam stop in place when the beam is perpendicular to the east and west walls. It is estimated that the beam stop will be in place 98 percent of the time. With beam stop in place the unit can operate throughout 360 degrees.

Beam Stops: Mr. Chalk furnished the following information in a phone conversation today, August 9, 1984:

a. Anticipated patient load per day: 16
Treatments per patient per week: 5
Assumed dose per patient per day: 200

From these assumptions the workload is calculated to be 10,240 R per week at one meter.

The maximum number of patients treated per hour would be 4. And the maximum number of patients per week would be 30. These are the same number given in NCRP 49 with a workload of 40,000 R per week at one meter. These would represent a maximum.

Treatment time and on time "per hour" will depend on source activity and machine output. The maximum output per patient per day would not exceed 400 rads. If 400 rads per patient were being given then it would not be possible to treat 4 patients per hour since patients receiving this amount of radiation are generally very critical and they need extensive care and supervision in treating and setting up which would add to the time needed.

b. Beam orientation. The beam can be pointed in any direction. The unit indicator is as follows;

Direction	Beam Pointed
0	Down
90	East wall barrier B
180	Up
270	West wall barrier A

The head of the unit is capable of rotating toward the North wall 90 degrees. Towards the South wall it can rotate 30 degrees. The head motion will be mechanically restricted to the plane of rotation, i.e. the beam will not point toward the north or south wall whatsoever. For the direction of North in relation to the room layout see Item 9a of 7/12/84

c. Maximum field size is 35 by 35 centimeters.
The distance to scattering material is 80 cm.
The distance to the beam absorber is approximately 150 cm.
The beam stop intercepts an area of 70 degrees, 35 degrees from the center of the absorber in either direction in the place of rotation.
Scatter angle (worst case) is 30 degrees
Scatter Radiation (worst case) is 0.0060. The is taken from NCRP 49 Table B-2, page 59. In the calculations to follow the value of 0.0060 is used for the scattering ratio in most cases. In some of the calculations the value of 0.0009 is used which is the value for 90 degree scatter, again from the same reference given above.

Barrier	Distance in meters to	
	Absorber	Area of Concern
A	2.3	4.4
B	2.3	3.4
C*		
D	5.3	6.1
E	3.35	4.0
F	2.9	4.0
G	2.3	2.8
CEILING	2.8	4.3
DOOR**	6.7	6.7

*The distance to barrier C is to the wall of the maze entering the room. The area behind it is not occupied during any treatment.

**The distance to the door presents two scatters, one of 4.0 meters and the other of 2.7 meters.

The distances were derived from the blue prints which were drawn at a scale of 1/4 inch equals 1 foot.

d. Leakage is assumed to be 0.1 percent of the primary radiation.
Leakage through the beam stop is 0.05 percent from the manufacturers specifications.
The use factors are those given in NCRP 49 Table 3 page 64. These are

1/4 for the east and west walls and the ceiling and a use factor of 1 for the floor.

Only barriers E. F. and the Door enter restricted areas. The rest are considered unrestricted.

The calculations are included in the following table.

It should be noted that the limits 10 CFR Part 20.105(b)(1)and (2) will not be exceeded in the changing of the units, since the unit currently in place does not have a beam stop and the new unit will. It is reported by the manufacturer that the beam stop will attenuate all but 0.05 percent of the primary beam. In addition, for almost all treatments the beam stop will be in place. Therefore, without the calculations it can be reasoned that the necessary limits will not be exceeded. Of course, with the completion of the installation the dose levels at the various locations with and without beam stop will be verified and the report will be furnished to the NRC as required. If there are further questions please contact me.

Sincerely yours,

M. V. Broadbent, PhD

M. V. Broadbent, PnD,MACR

Barrier	Distance	Workload	$1/d^2$	Use	Scatter Coefficient	Transmissions Beam Stop	Transmissions Wall	mR/hr	mR/week	Totals
A Primary	4.4	40,000	$5.2X10^{-2}$	1/4		$5X10^{-4}$	$6.2X10^{-6}$	$4.0x10^{-5}$	$1.6X10^{-3}$	
Primary				1/4		($2X10^{-2}$)	$6.2X10^{-6}$	$1.6X10^{-6}$	$6.4X10^{-5}$	
Scatter				1	$6X10^{-3}$		$6.2X10^{-6}$	$1.9X10^{-3}$	$7.7X10^{-2}$	
Leakage				1		$1X10^{-3}$	$6.2X10^{-6}$	$3.2X10^{-4}$	$1.3X10^{-2}$	$2.3X10^{-3}$hr
										$9.2X10^{-2}$wk
B Primary	4.4	40,000	$5.2x10^{-2}$	1/4		$5X10^{-4}$	$6.2X10^{-6}$	$4.0x10^{-5}$	$1.6x10^{-3}$	
Primary				1/4		($2X10^{-2}$)	$6.2X10^{-6}$	$1.6X10^{-5}$	$6.4X10^{-5}$	
Scatter				1	$6X10^{-3}$		$6.2X10^{-6}$	$1.9X10^{-3}$	$7.7x10^{-2}$	
Leakage				1		$1X10^{-3}$	$6.2X10^{-6}$	$3.2X10^{-4}$	$1.3X10^{-2}$	$2.3X10^{-3}$hr
										$9.2X10^{-2}$wk
B*Primary	4.4	40,000	$5.2X10^{-2}$	1/4		$5X10^{-4}$	$1.8X10^{-4}$	$1.2X10^{-3}$	$4.7X10^{-2}$	
Primary				1/4		($2X10^{-2}$)	$1.8X10^{-4}$	$4.7X10^{-2}$	1.9	
Scatter				1	$6X10^{-3}$		$1.8X10^{-4}$	$5.6X10^{-2}$	2.2	
Leakage				1		$1X10^{-3}$	$1.8X10^{-4}$	$9.4X10^{-3}$	$3.7X10^{-1}$	$1.1X10^{-1}$hr
										4.5 wk
D Scatter	6.1	40,000	$2.7x10^{-2}$	1	$6X10^{-3}$		$3.0X10^{-4}$	$4.9X10^{-2}$	1.9	
Leakage				1		$1X10^{-3}$	$3.0X10^{-4}$	$8.1X10^{-3}$	$3.2X10^{-1}$	$5.7X10^{-2}$hr
										2.2 wk
E Scatter	4.0	40,000	$6.2X10^{-2}$	1	$9X10^{-4}$		$2.8X10^{-6}$	$1.6X10^{-4}$	6.3	
Leakage				1		$1X10^{-3}$	$9.5X10^{-3}$	$5.9X10^{-1}$	24	$5.9X10^{-1}$hr
										30.3 wk
F Scatter	4.0	40,000	$6.2X10^{-2}$	1	$9X10^{-4}$		$2.1X10^{-4}$	$1.2X10^{-2}$	$4.7X10^{-1}$	
Leakage				1		$1X10^{-3}$	$2.1X10^{-4}$	$1.3X10^{-2}$	$5.2X10^{-1}$	$2.5X10^{-2}$hr
										$9.9X10^{-1}$wk
G Scatter	2.8	40,000	$1.3X10^{-1}$	1	$9X10^{-4}$		$9.6X10^{-4}$	$1.1X10^{-1}$	4.5	
Leakage				1		$1X10^{-3}$	$9.6X10^{-4}$	$2.4X10^{-2}$	$9.6X10^{-1}$	$1.3X10^{-1}$hr
										5.5 wk
Ceiling Pri	4.3	40,000	$5.4X10^{-2}$	1/4		$5x10^{-4}$	$3.0X10^{-5}$	$2.0X10^{-2}$	$8.1X10^{-1}$	
Scatter				1	$6X10^{-3}$		$3.0X10^{-5}$	$9.7X10^{-3}$	$3.9X10^{-1}$	
Leakage				1		$1X10^{-3}$	$3.0X10^{-5}$	$1.6X10^{-1}$	$6.5X10^{-2}$	$1.9X10^{-1}$hr
										1.3 wk
Door										
Scatter	4.0	40,000	$6.3X10^{-2}$	1	$6.0X10^{-3}$		$3.0X10^{-3}$			
	2.7		$1.4X10^{-1}$	1	$6.0X10^{-3}$		$3.0X10^{-3}$	$1.6X10^{-1}$	6.4	
Leakage	4.0		$6.3X10^{-2}$	1		$1X10^{-3}$	$3.0X10^{-3}$			
	2.7		$1.4X10^{-2}$	1		$1X10^{-3}$	$3.0X10^{-3}$	$2.6X10^{-2}$	1.1	$1.9X10^{-1}$hr
										7.5 wk

*Snielding for the cut out portion in barrier B.

Beam stop items in parenthesis represent the 2 percent of the time the unit is used without the beam stop.