BIO-MED ASSOCIATES, INC.
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March 9, 2021 **(UPDATED_03.29.2021)**

Robert Yates
Good Samaritan Hospital
255 Lafayette Ave.
Suffern, NY 10901

Dear Mr. Yates,

This report specifies the radiation protection requirements for the new Philips CT X-Ray room to be installed at Good Samaritan Hospital, Suffern, NY. This report is based upon the architectural drawing N-EAS190435 E (A2) dated 2-18-21 from Philips.

The calculations applied in this report were made in accordance with the recommendations of the National Council on Radiation Protection (NCRP) Report Number 147, and in accord with regulations of the State of New York.

Specifications for each barrier are enclosed. Shielding specifications are the minimum required thickness. Lead sheets of greater thickness may be substituted. Also enclosed are recommendations concerning structural details and notes. Any changes to the drawing, including the location of equipment, position of wall barriers, or change in occupancy or use of adjacent areas, etc, will necessitate recalculation of the shielding specifications.

After installation is complete, please contact me to confirm shielding integrity by performing a radiation protection survey of the facility.

If you require further information, please do not hesitate to contact me.

Thank you for choosing the radiological physics services of Bio-Med Associates.

Sincerely:

BIO-MED ASSOCIATES, INC.

Thomas J. LaRocca, M.S., D.A.B.R.
Radiological Physicist

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SHIELDING SUMMARY

Date: March 9, 2021 **(UPDATED_03.29.2021)**

FACILITY INFO

Facility:	Good Samaritan Hospital	**Phone:**	845-368-5000
Address:	255 Lafayette Avenue	**State:**	NY
City:	Suffern	**Zip:**	10901

ASSUMPTIONS

This report is based upon the architectural drawing N-EAS190435 E (A2) dated 2-18-21 from Philips.
CT Workload: 180 patients/week; Conservative Calculations utlizing 140 kVp.
Above - Roof; Below - Earth/Slab - no shielding required.

BARRIER SHIELDING SUMMARY

Barrier ID	Barrier Type	Shielding Material	Existing Shielding (inches)	Additional Shielding (inches)	Comments
CT Control Room	Secondary	Lead	Two 5/8" Gypsum	1/16" Pb	Glass + Door: 1.5 mm Pb
Corridor / Prep Area	Secondary	Lead	Two 5/8" Gypsum	1/16" Pb	
Corridor Entrance Door	Secondary	Lead		3/64" Pb	
Equipment Room	Secondary	Lead	Two 5/8" Gypsum	3/64" Pb	Wall & Door
Nurses Office	Secondary	Lead	Two 5/8" Gypsum	5/64" Pb	2.0 mm Pb equivalent
Corridor	Secondary	Lead	Two 5/8" Gypsum	1/32" Pb	
Ceiling & Floor	Secondary	Lead	Concrete Slabs	NONE	Above roof, below Earth/slab

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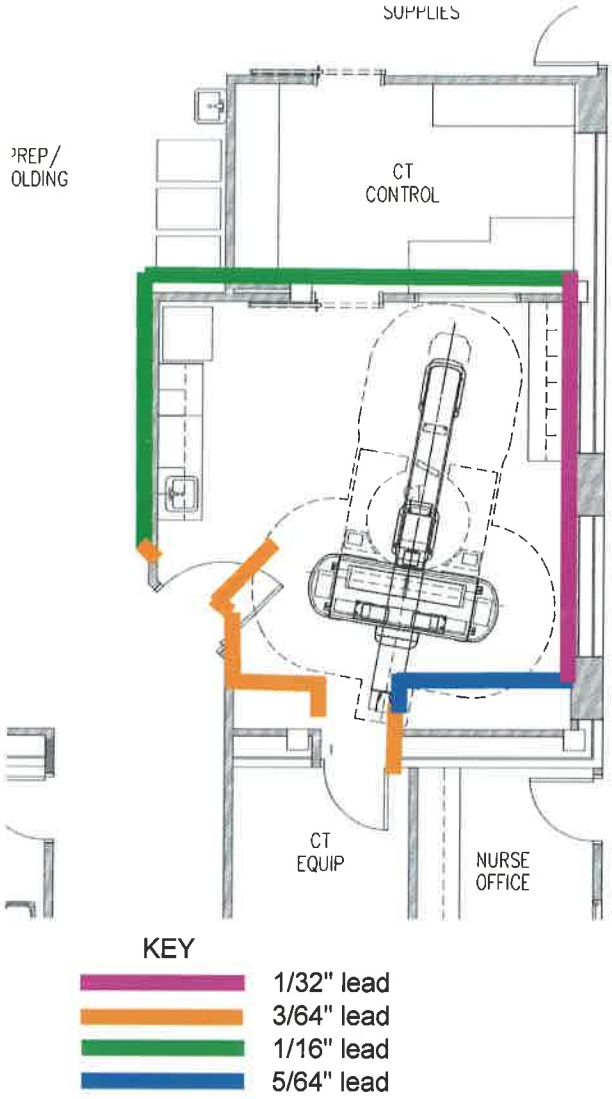
ATTACHMENT DRAWING - NEW CT X-RAY ROOM



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Attachment A: Barrier Calculations

HEAD CASES	
Scatter fraction k (cm^{-1})	9.0E-05
K^1_{sec} *(mGy/pt)*	0.151
DLP *(mGy cm)*	1200
Increase b/c contrast *(mGy cm)*	1680
Typical Technique *(mAs)*	300
Average length Scanned *(cm)*	20
Number of Cases/wk	40
Typical Pitch	1
Typical kVp	140
Studies with contrast	40%

BODY CASES	
Scatter fraction k (cm^{-1})	3.0E-04
K^1_{sec} *(mGy/pt)*	0.277
DLP *(mGy cm)*	550
Increase b/c contrast *(mGy cm)*	770
Typical Technique *(mAs)*	300
Average length Scanned *(cm)*	50
Number of Cases/wk	140
Typical Pitch	1
Typical kVp	140
Studies with contrast	40%

Barrier 1: *Control Room*
Barrier Type: *Secondary*
Shielding Material: *Lead*

K_{sec} ***(mG/wk)*** = 1.9
B = 1.03E-02

Design Goal **P** (mGy/wk):	0.02
Occupancy **T:**	1
Distance **d** (m)	4.80

	Lead	Concrete
NCRP Transmission Curve Used:	Figure A.2	Figure A.3
Total Barrier thickness (mm):	1.19	120.40
Inherent Shielding (mm):		
Required Shielding (mm):	1.19	120.40
Required Shielding (in):	1/16	

Barrier 2: *Corridor / Pt Prep Area*
Barrier Type: *Secondary*
Shielding Material: *Lead*

K_{sec} ***(mG/wk)*** = 2.8
B = 1.43E-02

Design Goal **P** (mGy/wk):	0.02
Occupancy **T:**	1/2
Distance **d** (m)	4.00

	Lead	Concrete
NCRP Transmission Curve Used:	Figure A.2	Figure A.3
Total Barrier thickness (mm):	1.08	110.97
Inherent Shielding (mm):		
Required Shielding (mm):	1.08	110.97
Required Shielding (in):	3/64	
Will recommend in report 1/16" Pb	1/16" Pb	

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Barrier 3: *Corridor entrance door* — K_{sec} *(mG/wk)* = 4.4
Barrier Type: *Secondary* — **B** = 3.65E-02
Shielding Material: *Lead*

Design Goal **P** (mGy/wk): 0.02
Occupancy **T**: 1/8
Distance **d** (m): 3.20

	Lead	Concrete
NCRP Transmission Curve Used:	Figure A.2	Figure A.3
Total Barrier thickness (mm):	0.78	84.36
Inherent Shielding (mm):		
Required Shielding (mm):	0.78	84.36
Required Shielding (in):	1/32	
Will recommend in report 3/64" Pb	**3/64" Pb**	

Barrier 4: *Equipment Room* — K_{sec} *(mG/wk)* = 6.2
Barrier Type: *Secondary* — **B** = 2.60E-02
Shielding Material: *Lead*

Design Goal **P** (mGy/wk): 0.02
Occupancy **T**: 1/8
Distance **d** (m): 2.70

	Lead	Concrete
NCRP Transmission Curve Used:	Figure A.2	Figure A.3
Total Barrier thickness (mm):	0.88	93.90
Inherent Shielding (mm):		101.60
Required Shielding (mm):	0.88	-7.70
Required Shielding (in):	**3/64" Pb**	

Barrier 3: *Nurses Office* — K_{sec} *(mG/wk)* = 6.2
Barrier Type: *Secondary* — **B** = 3.25E-03
Shielding Material: *Lead*

Design Goal **P** (mGy/wk): 0.02
Occupancy **T**: 1
Distance **d** (m): 2.70

	Lead	Concrete
NCRP Transmission Curve Used:	Figure A.2	Figure A.3
Total Barrier thickness (mm):	1.62	153.80
Inherent Shielding (mm):		
Required Shielding (mm):	1.62	153.80
Required Shielding (in):	5/64	

Barrier 4: *Corridor* — K_{sec} *(mG/wk)* = 5.0
Barrier Type: *Secondary* — **B** = 8.03E-02
Shielding Material: *Lead*

Design Goal **P** (mGy/wk): 0.02
Occupancy **T**: 1/20
Distance **d** (m): 3.00

	Lead	Concrete
NCRP Transmission Curve Used:	Figure A.2	Figure A.3
Total Barrier thickness (mm):	0.55	62.68
Inherent Shielding (mm):		101.60
Required Shielding (mm):	0.55	-38.92
Required Shielding (in):	1/32	

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Definitions:

Primary Barrier - Barrier sufficient to attenuate the useful beam to the required degree.

Secondary Barrier - Barrier sufficient to attenuate the stray (leakage and scattered) radiation to the required degree. The secondary barrier may not intercept the useful beam.

Controlled Area - A defined area in which the exposure of persons to radiation is under the supervision of a Radiation Protection Supervisor. (This implies that a controlled area is one that requires control of access, occupancy, and working conditions for radiation protection purposes).

Non-controlled Area - Any space not meeting the definition of controlled area.

Use Factor [Beam Direction Factor (U)] - Fraction of the workload during which the radiation under consideration is directed at a particular barrier.

Occupancy Factor (T) - The factor by which the workload should be multiplied to correct for the degree of occupancy of the area in question while the source is "ON".

Workload (W) - The degree of use of an x-ray or gamma ray source. For x-ray equipment operating below 4 MV, the workload is usually expressed in milliampere minutes per week. For gamma-beam therapy sources, and for x-ray equipment operating at 4 MV or above, the workload is usually stated in terms of the weekly exposure of the useful beam at one meter from the source and is expressed in roentgens per week at one meter.

Maximum Permissible Dose Equivalent (MPD) - For radiation protection purposes, maximum dose equivalents that persons shall be allowed to receive in a stated period of time. For radiation protection purposes of this report, the dose equivalent in rems may be considered numerically equal to the absorbed dose in rads and the exposure in roentgens.

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Structural Details of Protective Barriers

1. Lead barriers shall be mounted in such a manner that they will not sag or cold-flow because of their own weight. They shall be protected against mechanical damage. It is recommended that lead of 1/32 inch or less thickness be bonded to panels of some rigid supporting material.

2. Surfaces of lead sheets at joints in the barrier should be in contact with a lap of at least 1/2 inch or twice the thickness of the sheets, whichever is greater.

3. Welded or burned lead seams are permissible, provided the lead equivalent of the seams is not less than the minimum requirement of the barrier.

4. Joints between different kinds of protective materials shall be so designed that the overall protection of the barrier is not impaired.

5. Joints at the floor and ceiling shall be so designed that the overall protection is not impaired.

6. Windows, window frames, doors and door frames shall have the same lead equivalent as that required of the adjacent wall. Where thick concrete walls are tapered into openings, as is frequently done with observation windows, it may be necessary to add lead protective flanges around the window frame to compensate for the reduced thickness of concrete. A door baffle or threshold may be required for installations operating above 125 kVp, if the discontinuity can be struck by the useful beam. Special attention should be given to providing overlap of the shielding of the door frame and the shielding of the door.

7. Holes in protective barriers shall be covered so that overall attenuation is not impaired.

8. Louvers and holes in barriers for pipes, conduits, service boxes and air ducts may require baffles to insure that the overall protection afforded by the barrier is not impaired. It is advisable to locate such holes outside of the range of direction of the useful beam.

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Notes:

1. The minimum height recommended by the NCRP is 7 feet 0 inches from the floor to the ceiling for all lead lined wall partitions. When the ceiling has a shielding requirement, the wall specification should extend from the floor to the ceiling.

2. The door frame should be carefully installed with overlapping pieces of lead so that no gaps are created.

3. Cassette Holder - The cassette holder should be mounted as specified by manufacturer.

4. The pass box should be installed as recommended in manufacturer's specifications. Care should be taken on installation of pass box such that gaps are not created when installed. Lead pieces bent to right angels should be fitted around all sides of the pass box.

5. The control booth should be lead lined to 1/16 inch of lead, and the window should have lead glass equivalent to 1/16 inch of lead.

6. All connections in the wall, (i.e. electrical outlets, plumbing, etc.), should have lead in the back of the cutouts in the wall overlapping the lead lined wall so that holes are not created. All corners should be sealed such that gaps are not created in the corner of the room.

7. The type and manufacturer of lead lining used in the X-ray Room should be specified by the general contractor or architect.

8. When a shielded door does not exist, the edge of the observation window should be at least 18 inches from the edge of the control partition.

9. Shielding specifications are the minimum required thickness; lead sheets of greater thickness may be substituted. Lead sheets less than 1/32 inch are usually more expensive than thicker sheets.