Beebe

424 Savannah Road, Lewes DE, 19958
beebehealthcare.org (302) 645-3300

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03013331

July 21, 2017

Licensing Branch
Nuclear Materials Safety Section
Division of Safety & Safeguards
Region I
475 Allendale Road
King of Prussia, PA 19406

RE: License No. 07-17792-01

Dear Sir or Madam:

We hereby notify the Nuclear Regulatory Commission that we have finished renovation of our PET/CT scan room are no longer using the PET/CT van that we had rented from Diagnostic Imaging Rental Services, Tennessee license number R-78008-F27.

Please note: No PET radionuclides are produced nor there exists any PET radioactive drug delivery line are installed in our newly renovated PET/CT room. PET radionuclides are delivered by a pharmacy to our Hot lab/ Injection room as before.

A copy of the shielding plan of the renovated space is enclosed.

If additional information is needed or there are any questions regarding our plans, please contact our Radiation Safety Officer, Mr. Malek Daneshvar or myself.

Sincerely,

Dan Mapes, MPA, RT(N), CRA
Executive Director, Diagnostic & Satellite Services
302-645-3709 office
302-448-6596 cell

600496
NMSS/RGN1 MATERIALS-002

KGHP
KRUEGER-GILBERT HEALTH PHYSICS

809 Gleneagles Court, Suite 100
Towson, MD 21286
410-339-5447
www.kruegergilbert.com

1/9/17

Mr. Dan Mapes
Department of Radiology
424 Savannah Road
Lewis, DE 19958

Dear Mr. Mapes:

Enclosed is the x-ray design and shielding recommendations for the replacement PET/CT Scanner at the Beebe Health Campus.

Krueger-Gilbert Health Physics, Inc. has prepared the application for "Approval to Construct" that you must submit to the Delaware division of Public Health.

Please take the following action:

Submit to the State the following:

a. Delaware Application for Plan Review and Form OE-R15A
b. Copy of complete design and shielding recommendation prepared by Krueger-Gilbert Health Physics, Inc.
c. Scaled diagrams of facility and equipment layout; for your convenience, these have been attached to the application.

At the following address: Delaware Division of Public Health
Office of Engineering
43 S. Dupont Highway
Dover, Delaware 19901

Note: Upon review and approval, the Office of Engineering will issue an "Approval to Construct" letter. Following construction, you must contact the Office of Radiation Control to arrange for a pre-operational onsite inspection.

Any questions regarding this report should be directed to the undersigned.

Sincerely,

M. Daneshvar

Malek Daneshvar, MS, CHP, DABR
Diagnostic Medical Physicist

DESIGN AND SHIELDING RECOMMENDATIONS

FOR

PET – CT Replacement

Beebe Health Campus
18941 John J. Williams Highway
Rehoboth Beach, Delaware 19971-4404

January 9, 2017

BY

KRUEGER-GILBERT HEALTH PHYSICS, INC.
809 GLENEAGLES COURT, SUITE 100
TOWSON, MARYLAND 21286
(410) 339-5447

X-RAY SHIELDING RECOMMENDATIONS

REFERENCES

National Council on Radiation Protection and Measurements, Report No. 147, "Structural Shielding Design for Medical X-Ray Facilities," November 2004.

National Council on Radiation Protection and Measurements, Report No. 102, "Medical X-ray and Gamma-Ray Protection for Energies up to 50 MeV--Equipment Design and Use," June, 1989.

AAPM Task Group 108: PET and PET/CT Shielding Requirements, Med. Phys. 33 (1), January 2006.

American Association of Physicists in Medicine, Report No. 39, "Specifications and Acceptance Testing of Computed Tomography Scanners", May, 1993.

Anderson, Jon A. "PET and PET/CT Shielding", March 2005, SEAAPM Meeting, 3/2005.

Courtney, J.C.; Mendex, P.; Hidalgo-Salvatierra, O.; Bujenovic, "Photon Shielding for a Position Emission Tomography Suite", Health Phys. 81 (Supplement): 524-528; 2001.

"The Use of Plate Glass as Shielding Material in Diagnostic Radiologic Installations," by E. Dale Trout et al, September 1974.

"X-ray Attenuation in Steel--50 to 300 kVp," by E. Dale Trout et al, July 1975.

U.S. Standard Gauge for Sheet Steel, Table 20-2H, American Institute of Steel Construction, Inc.

Delaware Regulations: Administrative Code, Title 16

Proceedings of the 1997 AAPM Summer School; "New Concepts for Radiation Shielding of Medical Diagnostic X-ray Facilities" by Robert Dixon et al.

Room Layout

The workload information, barrier designation, structural composition, degree of occupancy of adjacent areas and distance variables are provided by Mr. Dan Mapes.

The location of individual walls, referenced in this report, is indicated on the enclosed sketch

Use Factor, U and Occupancy, T

Occupancy and use factors have been assigned in accordance with NCRP Report # 147 and/or as discussed or observed for this facility.

Workload

The workload is based upon information provided by Mr. Dan Mapes.

The weekly workload is as follows:

F-18	Scan Room; 30 patients/week, 30 min scan/patient; 60 min wait/patient; 15 mCi/patient.
CT	assumed 40 body procedures and 20 head procedures/week at 20% contrast.

Assumptions

- Occupancy factors from NCRP 147 (guidance) or as discussed/observed.
- Distances measurements include 0.3 meters from respective walls.
- No occupancy below and above (one story building);
- Shielding calculations for the HotLab/Injection area was performed on May 16, 2011. This area will not be affected by the PET/CT replacement.

3. METHOD

3.1 Barrier Estimation for 511 keV Photons (PET)

Calculation formalism proposed by the task group AAPM Task Group 108 (2006) and Anderson (2005).

The required barrier transmission factor is calculated as:

$$B = \frac{Pd^2}{A\, tR_t \Gamma NT} \qquad (1)$$

Where:
P = weekly design exposure rate, controlled or uncontrolled, (2 mrem/week or 10 mrem/week)
d = distance from the injected patient to the person to be protected, (m)
A = initial activity in mCi
t = integration time – the time the source is in the place- (hours)
R_t = reduction factor- decay during integration, (AAPM 108 & Anderson, 2005)
Γ = gamma factor for ^{18}F injected patients with, 0.34 (mrem/h) per mCi @ 1 m (AAPM 108 & Anderson, 2005)
N = number of patients per week
T = occupancy factor (NCRP 147).

The lead thickness is identified from attenuation curves (transmission vs. thickness), (AAPM 108 & Anderson, 2005).

3.2 Barrier Estimation for 120/140 kVp x-Ray spectrum (CT).

Method based on the dose length product factor described in the NCRP 147.

All barriers have been treated as secondary barriers. The secondary air-kerma values at 1 m are given by:

$$k^1_{\text{sec}}(head) = c * k_{head} * DLP \qquad (5)$$

and

$$k^1_{\text{sec}}(body) = 1.2 * c * k_{body} * DLP \qquad (6)$$

where:

$k^1_{\text{sec}}(head); k^1_{\text{sec}}(body)$ = secondary air-kerma (mGy/procedure) for typical body and head procedures

$k_{head}; k_{body}$ = the measured k values listed in NCRP 147 (i.e., k_{head}= 9x10^{-5} cm^{-1} and k_{body}=3x10^{-4} cm^{-1});

DLP = dose length product from Table 5.2, NCRP 147;

c = the contrast factor, e.g., c =1.4 for a 40% contrast faction.

The transmission factor is then given by:

$$B = \frac{Pd^2}{T\left(k^1_{\sec}(head)N_{head} + k^1_{\sec}(body)N_{body}\right)} \qquad (7)$$

where:

P = weekly design exposure rate, controlled or uncontrolled,(mGy/week);
d = distance from isocenter to person to be protected, (m);
N_{head}= number of head procedures per week
N_{body}= number of body procedures per week
T = occupancy factor

Given the barrier transmission (B), the required shielding thickness of a specific material can be computed with equation (4) and fitting coefficients taken from Figures A2 and/or A3 of NCRP 147.

The results obtained with this method were consisted with the ones derived through other approaches (iso-doses, etc). The most conservative values were enclosed in the attached Table.

The overall results for the 511 keV and 140 kVp shielding are presented in the attached Table together with the recommended barrier thickness to be added.

Specific Shielding Requirements

Barrier	Designation	Distance (meter)	Design Limit mGy/week	Occupancy (T)	Minimum Shielding Needed (in addition to standard building material)
A (corridor)	Secondary	4.3	0.02	1/5	1.59 mm lead
B (control booth)	Secondary	3.0	0.1	1	1.59 mm lead
C (adjacent x-ray)	Secondary	4.6	0.1	1	1.59 mm lead
D (lab)	Secondary	2.3	0.02	1/5	1.59 mm lead
E (lab)	Secondary	2.7	0.02	1/5	1.59 mm lead
F (corridor)	Secondary	2.0	0.02	1/2	1.59 mm lead
Floor & ceiling	No occupancy				

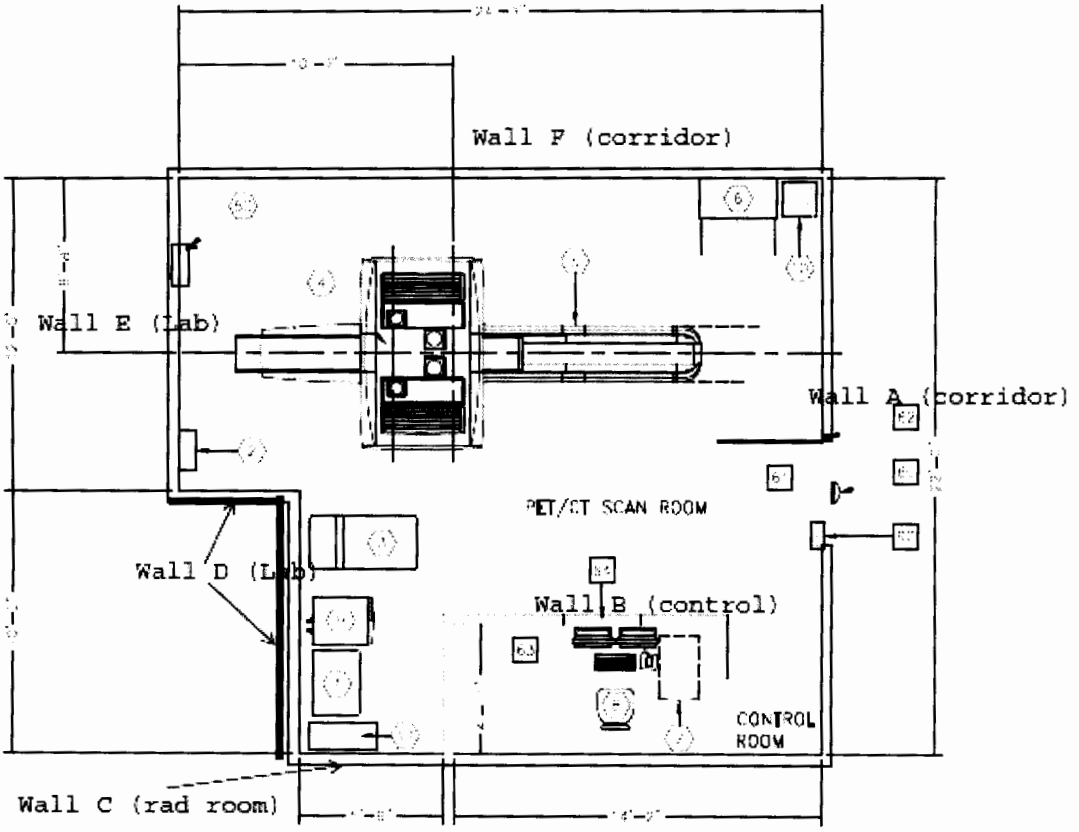
A copy of this report should be maintained on file for future reference in the event questions arise involving radiation exposure.

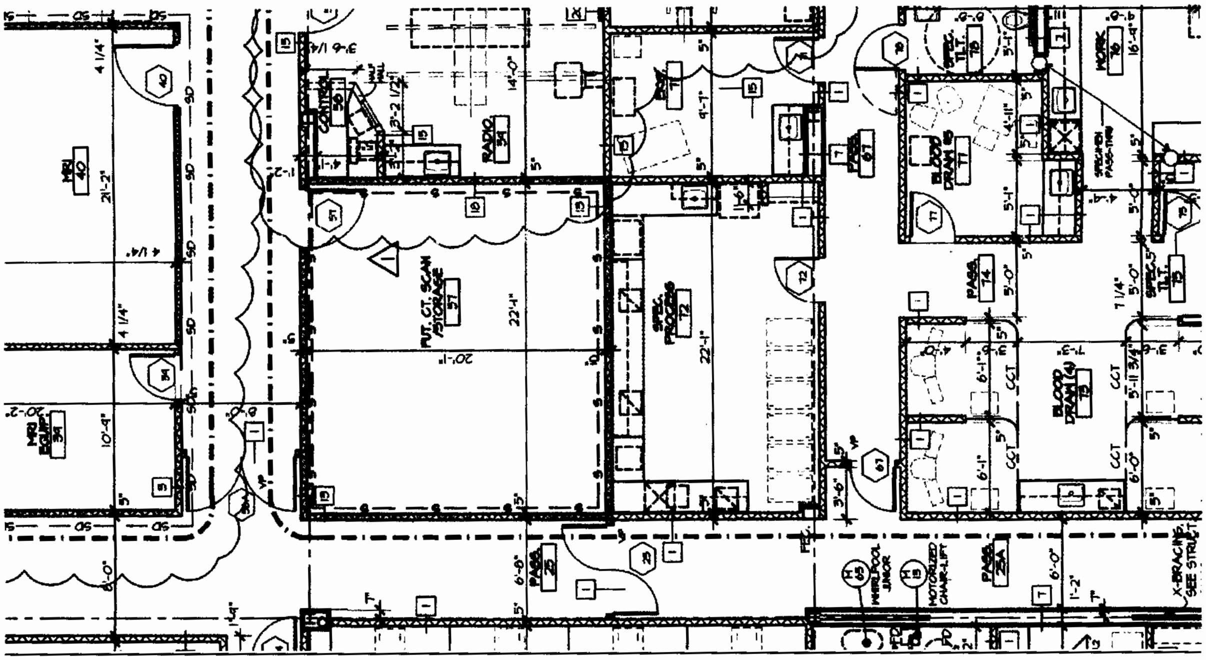
Krueger-Gilbert Health Physics, Inc., assumes no liability for damage arising as the result of changes in the design specification and assumptions contained in this report including changes in workloads, use factors, occupancy factors, x-ray units, and construction specifications. Any such changes should only be undertaken after consultation with qualified experts in radiation protection, such as ourselves.

If you have any questions concerning this report please contact the office of Krueger-Gilbert Health Physics, Inc.

Sincerely,

Malek Daneshvar, MS, CHP, DABR
Diagnostic Medical Physicist


Wall F (corridor)
Wall E (Lab)
Wall A (corridor)
PET/CT SCAN ROOM
Wall D (Lab)
Wall B (control)
CONTROL ROOM
Wall C (rad room)


MRI 40
MRI EQUIP. 34
RADIO 34
FUT. CT SCAN /STORAGE 57
SPEC. PROCESS 72
BLOOD DRAW 71
BLOOD DRAW (4) 73
PASS 74
PASS 25
PASS 25A
X-BRACING, SEE STRUCT.

NRC FORM 532
(05-2016)

U.S. NUCLEAR REGULATORY COMMISSION

ACKNOWLEDGEMENT - RECEIPT OF CORRESPONDENCE

Name and Address of Applicant and/or Licensee	Date
Beebe Medical Center c/o Radiology Department Attn: Malek Daneshvar 424 Savannah Road Lewes, DE 19958	8/23/2017
	License Number(s) 07-17792-01
	Mail Control Number(s) 600496
	Licensing and/or Technical Reviewer or Branch Medical Branch

This is to acknowledge receipt of your: ☑ **Letter and/or** ☐ **Application** **Dated:** 07/21/2017

The initial processing, which included an administrative review, has been performed.

☑ **Amendment** ☐ **Termination** ☐ **New License** ☐ **Renewal**

☑ **There were no administrative omissions identified during our initial review.**

☐ **This is to acknowledge receipt of your application for renewal of the material(s) license identified above. Your application is deemed timely filed, and accordingly, the license will not expire until final action has been taken by this office.**

☐ **Your application for a new NRC license did not include your taxpayer identification number. Please complete and submit NRC Form 531, Request for Taxpayer Identification Number, located at the following link: http://www.nrc.gov/reading-rm/doc-collections/forms/nrc531.pdf**

Follow the instructions on the form for submission.

☐ **The following administrative omissions have been identified:**

Your application has been assigned the above listed MAIL CONTROL NUMBER. When calling to inquire about this action, please refer to this control number. Your application has been forwarded to a technical reviewer. Please note that the technical review, which is normally completed within 180 days for a renewal application (90 days for all other requests), may identify additional omissions or require additional information. If you have any questions concerning the processing of your application, our contact information is listed below:

Region I
U. S. Nuclear Regulatory Commission
Division of Nuclear Materials Safety
2100 Renaissance Boulevard, Suite 100
King of Prussia, PA 19406-2713
(610) 337-5260, (610) 337-5313,
(610) 337-5398, or (610) 337-5239