

Beaumont Hospital
Royal Oak

November 24, 2009

U.S. Nuclear Regulatory Commission
Region III
Materials Licensing Section
2443 Warrenville Road, Suite 210
Lisle, Illinois 60532-4352

Addendum to Control No. 318243
NRC License No. 21-01333-01

Dear Ms. Casey:

In response to your telephone call on November 19, 2009, the description of the shielding for our two HDR rooms is as follows and has not changed since the NRC approved the two amendment submissions for each room.

HDR Facilities and Equipment

Two remote afterloading high dose rate (HDR) units (Nucletron) are located in the lower level of the central tower of Beaumont Hospital, Royal Oak. NRC Amendments #47 and #65 approved Room 2B0040 for a 10 Curie Ir-192 source. NRC Amendment #65 approved Room 2B0060 for a 10 Curie Ir-192 source. The shielding calculations have been revised to allow installation of a 12 Curie Ir-192 in each room. The maximum "on" time in any one hour is overestimated to be 20 minutes per hour per room as was previously submitted and approved by NRC. Both rooms were originally designed for 6 MV linear accelerators, which have been removed from the hospital. High density concrete was used throughout both rooms. The shielding for these two rooms is summarized in the Table below and shown on the diagrams in Appendix B.

Barriers	Shielding material, thickness
A	32" concrete
B	13" concrete + 12" Ledite (equivalent to 4" lead)
C	20" concrete
D	36" concrete
E	36" concrete
F	25" concrete + 0.25" lead

Addendum to Control No. 318243 dated November 24, 2009
NRC License No. 21-01333-01

3601 West Thirteen Mile Road
Royal Oak, Michigan 48073-6769
248-898-5000

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	22" concrete + 0.25" lead
G	13" concrete + 3 ¾" clay tile partition (equivalent to 15" standard density concrete)
H	13" concrete + 3 ¾" clay tile partition (equivalent to 15" standard density concrete)
I	20" concrete
J	36" concrete

Shielding Description and Calculations. See Appendix A

1. Scale

Marked on drawings (Appendix B)

2. Direction of North

Marked on drawings (Appendix B)

3. Identification of HDR rooms (i.e., room number)

2B0040 and 2B0060

4. Type, density and thickness of all shielding materials, walls, floor, ceiling.

High density concrete, Ledite, lead and clay tile. Thicknesses are indicated in the Table above.

5. Location of entrance and windows, etc.

Marked on the drawings (Appendix B)

6. Nature of and distance to adjacent areas

The contiguous areas are indicated on drawings in Appendix B. The area to which the Ir-192 source is confined is indicated on the drawings in Appendix B. The level above is the first floor of the hospital which includes a corridor and public area. There is nothing below the rooms. The area adjacent to HDR Room #1 (2B0060) was remodeled in 1998 to include a locker room, staff restroom and chemistry lab. Appendix B includes survey results for the locker room and staff restroom which are adjacent to room 02B0060 taken on April 30, 1998 and submitted to NRC for approval. The measured exposure rate was normalized to an activity of 12 Curie instead of 10 Curie Ir-192 and is shown in Appendix A to be 2.76 mR/hr continuous (maximum "on" time is 0.92 mR/hr). This, however, was not used in the final shielding calculations, normalized exposure rate, mR/hr, in any one hour, with maximum "on" time of 20 minutes.

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7. Occupancy of the adjacent areas (i.e., restricted or unrestricted)

All adjacent areas are assumed to be uncontrolled or unrestricted areas.

8. Only the patient will be in the treatment room during the use of the HDR source and devices. Any attempted entry into the room during the treatment time will cause the source to be withdrawn from the patient and into the HDR safe through the electronic interlock systems.

9. The maximum "on-time" per hour, per room is 20 minutes per hour, which is the same as approved by NRC in each amendment.

10. Calculations of the exposure rate in each adjacent area with the variable range for the source in each room are shown in Appendix A. Please note that the actual location for the Ir-192 source in HDR Room 1 (02B0060) is indicated by a '+' symbol on the Appendix B diagrams

11. The calculations ignore attenuation in the patient's body.

12. Unrestricted areas to meet the following condition: with "on" time of 20 minutes maximum per any one hour; occupancy = 1.0; variable source distance as shown on diagrams in Appendix B; the exposure rate must be less than or equal to 0.002 rem/hr in one hour.

Conclusions: The maximum normalized exposure rates in mR/hr in any one hour are calculated and shown to meet the NRC required exposure rate for an unrestricted area of less than or equal to 0.002 rem/hr. Refer to Appendices A and B.

For additional information, please contact Cheryl C. Schultz at 248-551-0548.

Sincerely,



Cheryl Culver Schultz, M.S.
Corporate Radiation Safety Officer

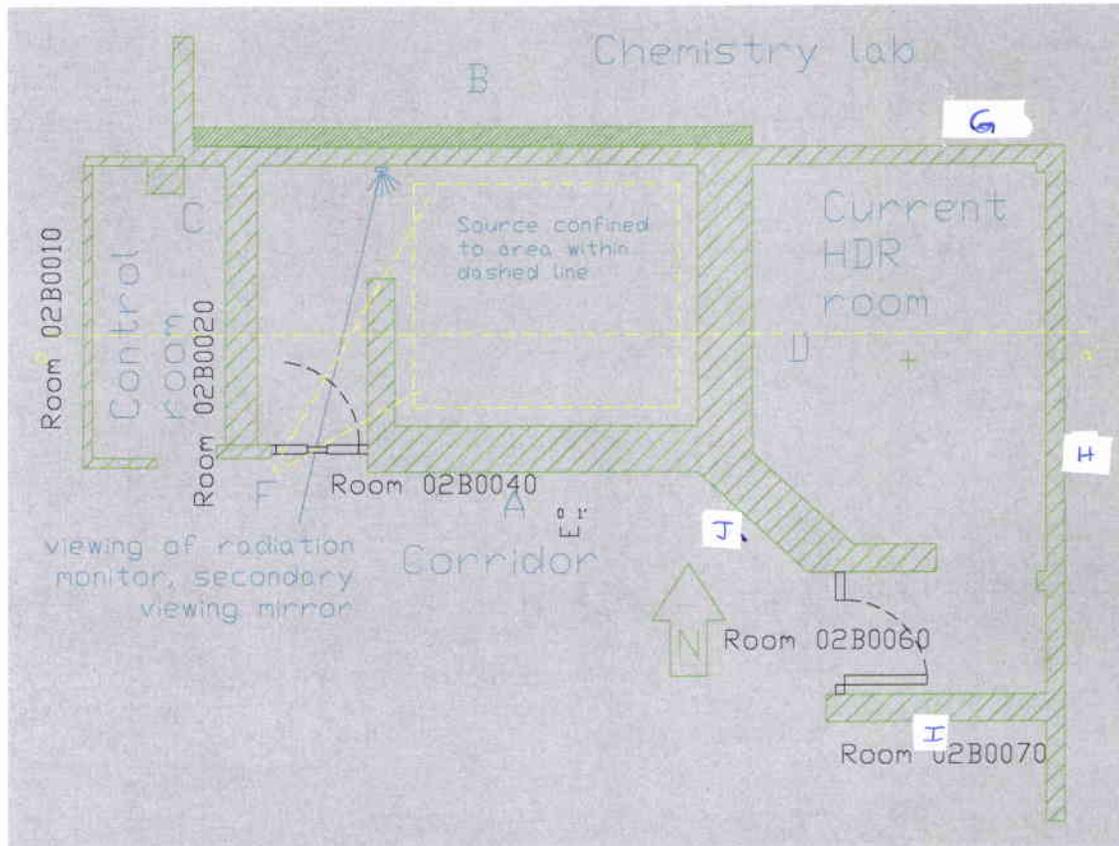
Appendix A: Revised Shielding Calculations for HDR Rooms

Shielding calculations submitted to U.S. NRC on November 24, 2009							
7 points are considered		4 points are considered					
HDR Room 02B0040		HDR Room 02B0060					
A in adjacent corridor		G in adjacent chemistry lab					
B in adjacent chemistry lab		H in locker room/staff toilet					
C in control room		I in control room					
D in current HDR brachy room		J in adjacent corridor					
E on floor above							
F at doorway							
Assumptions:							
Γ for $^{192}\text{Ir} = 0.466\text{R m}^2 \text{Ci}^{-1} \text{hr}^{-1}$		0.466 R m ² Ci ⁻¹ hr ⁻¹					
Source Activity = 12 Ci							
Tenth Value Layer (TVL) for ^{192}Ir for:		12 Ci					
concrete = 14.7 cm (NCRP 49, p. 89)		5.79 inches					
lead = 2.0 cm		0.79 inches					
Source position variable, but more than 12" from any wall for points A,B,C,D,F,I and J							
Source position variable, but more than 36" from any wall for points G and H							
All points are assumed to be 12" from adjacent wall							
Point E is assumed to be with source at 36" above floor							
Point	Direction	Distance, m	Shielding material, thickness	TVL	Instantaneous exposure rate, mR/hr	Measured exposure rate mR/hr	Normalized exposure rate, mR/hr in any one hour, with maximum "on" time 20 min
A	South	1.5	32" concrete	5.5	2485.333	0.00786	0.00
B	North	1.24	13" concrete + 12" Ledite (= 4" Pb equiv)	7.2	3636.837	0.00023	0.00
C	West	3.6	20" concrete	3.4	431.4815	0.17178	0.06
D	East	1.5	36" concrete	6.2	2485.333	0.00157	0.00
E	Above	6	36" concrete	6.2	155.3333	0.00010	0.00
F - 1	Doorway	5.2	25" concrete + 0.25" Pb	4.5	206.8047	0.00654	0.00
F - 2	Doorway	2.8	22" concrete + 0.25" Pb	4.1	713.2653	0.05666	0.02

Appendix A: Revised Shielding Calculations for HDR Rooms

G	North	1.52	13" concrete + 3 3/4" clay tile (=15" concrete equiv.)	2.6	2420.36	6.07967		2.01
H	East	1.52	13" concrete + 3 3/4" clay tile (=15" concrete equiv.)	2.6	2420.36	6.07967	2.76*	2.01
I	South	3.6	20" concrete	3.4	431.4815	0.17178		0.06
J	SW	1.6	36" concrete	6.2	2184.375	0.00138		0.00
*See the attached Survey Report dated April 30, 1998 and approved by NRC (Amendment No. 65)								

**APPENDIX B: SHIELDING CALCULATIONS AND EXPOSURE RATE TABLE
FACILITY DIAGRAMS**



Floorplan of HDR room and environs

Radiation Oncology – Royal Oak
 HDR Rooms
Treatment Room
02B0060

BSC
 Beacon Services Co.,
 L.L.C. 3601 West Thirteen
 Mile Road Royal Oak, MI
 48073-5798
 Phone 1.248.551.8380
 Fax 1.248.551.5540
 Facilities Development
 TECHNICAL INFORMATION
 GROUP

NORTH WALL =
 1/8" FINISH PLASTER,
 5/8" GYPSUM BOARD,
 4" METAL STUD,
 4" NOMINAL (3 3/4" ACTUAL)
 CLAY TILE PARTITION,
 1' - 1" POURED REINFORCED CONCRETE WALL,
 4" METAL STUD,
 5/8" FIRE RATED GYPSUM WALLBOARD.
 2' - 2 1/8" THICK OVERALL ASSEMBLY.

EAST WALL =
 1/8" FINISH PLASTER,
 4" NOMINAL (3 3/4" ACTUAL)
 CLAY TILE PARTITION,
 1' - 1" POURED REINFORCED
 CONCRETE WALL,
 7/8" HAT CHANNEL,
 5/8" FIRE RATED GYPSUM WALLBOARD.
 1' - 6 3/8" THICK OVERALL ASSEMBLY.

SOUTH WALL =
 1/8" FINISH PLASTER,
 1' - 8" POURED REINFORCED CONCRETE WALL,
 4" METAL STUD,
 5/8" GYPSUM BOARD,
 1/8" FINISH PLASTER.
 2' - 7/8" THICK OVERALL ASSEMBLY.

SOUTH WALL =
 1/8" FINISH PLASTER,
 1' - 8" POURED REINFORCED CONCRETE WALL.
 1' - 8 1/8" THICK OVERALL ASSEMBLY.

ANGLED WALL =
 1/8" FINISH PLASTER,
 3' - 0" POURED REINFORCED CONCRETE WALL,
 4" NOMINAL (3 3/4" ACTUAL)
 CLAY TILE PARTITION.
 3' - 3 7/8" THICK OVERALL ASSEMBLY.

WEST WALL =
 1/8" FINISH PLASTER,
 5/8" GYPSUM BOARD,
 4" METAL STUD,
 3" NOMINAL (2 3/4" ACTUAL)
 CLAY TILE PARTITION,
 3' - 0" POURED REINFORCED
 CONCRETE WALL,
 3" NOMINAL (2 3/4" ACTUAL)
 CLAY TILE PARTITION.

3' - 10 1/4" THICK OVERALL ASSEMBLY.

03A0230
 ST. TOILET

03A0210
 LOCKERS - 2

03A0215
 STORAGE

02B0060
 TREATMENT RM.

02B0070
 CONTROL RM.

02B0000
 HALLWAY

02B0080
 LOUNGE

02B0040
 X-RAY RM.

FLOOR =
 4" REINFORCED CONCRETE SLAB
 ON GRADE.

DECK ABOVE =
 3' - 0" POURED REINFORCED CONCRETE SLAB,
 1 1/2" FINISH CONCRETE TOPPING.

① LEAD LINED DOOR WITH
 LEADED GLASS VIEWING WINDOW,
 1/4" LEAD LINED FRAME.

CEILING (8'-0" AND 9'-0" AFF) =
 7/8" METAL FURRING-
 (HUNG FROM 1 1/2" CR CHANNEL),
 18 GA METAL FRAME,
 GALV. METAL LATH,
 3/4" PLASTER.



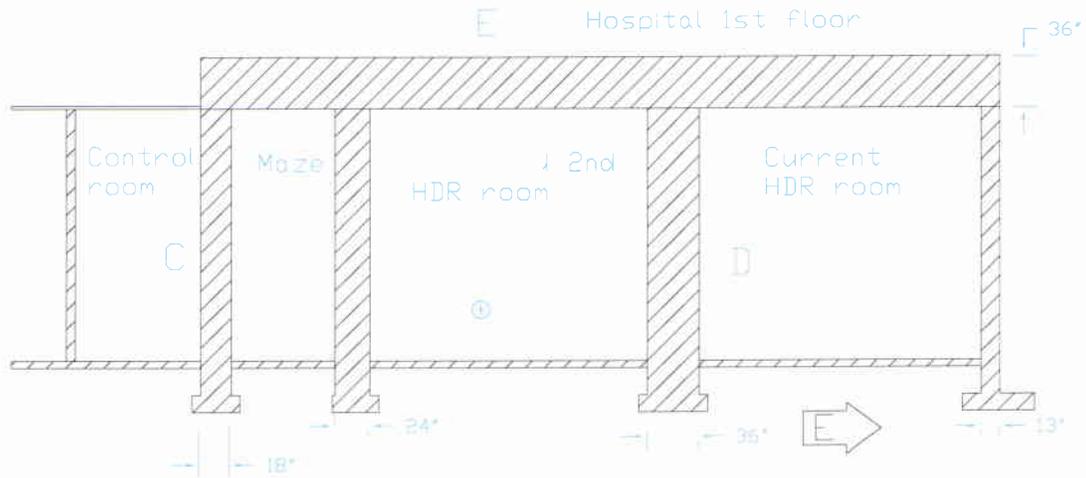
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DWG. NO.
SYSTEM DES.

CENTRAL TOWER-LL

1/8" = 1' - 0"

APPENDIX B: SHIELDING CALCULATIONS AND EXPOSURE RATE TABLE FACILITY DIAGRAMS



Elevation a-a' as marked above

APPENDIX B

Survey Report

Date of Survey: April 30, 1998

Survey purpose is to verify adequacy of shielding in the High Dose Rate (HDR) treatment room (designated room 02B0060--see enclosed floorplan). When the HDR room was commissioned, two of the walls were exterior basement walls. Since that time, the area around has been excavated and occupied, and now constitutes uncontrolled area.

Survey conditions:

The HDR source was exposed within the treatment room, without additional phantom material (often used to simulate attenuation in a patient's body). Source serial number 860 (calibration activity 9.03 Ci on 3/11/1998), activity at time of measurement 5.654 Ci.

The HDR source was placed 3 feet from the east wall, and the adjacent rooms were scanned to find the maximum exposure rate. The bathroom measurement (point A on the drawing) was made at one foot from the wall, the locker room measurement (point B on the drawing) was made at the locker surface.

Survey instrument: Victoreen 450P (high pressure ionization chamber survey meter), S/N 3091, calibration date 9/24/1997. Background: 15 μ R/hr.

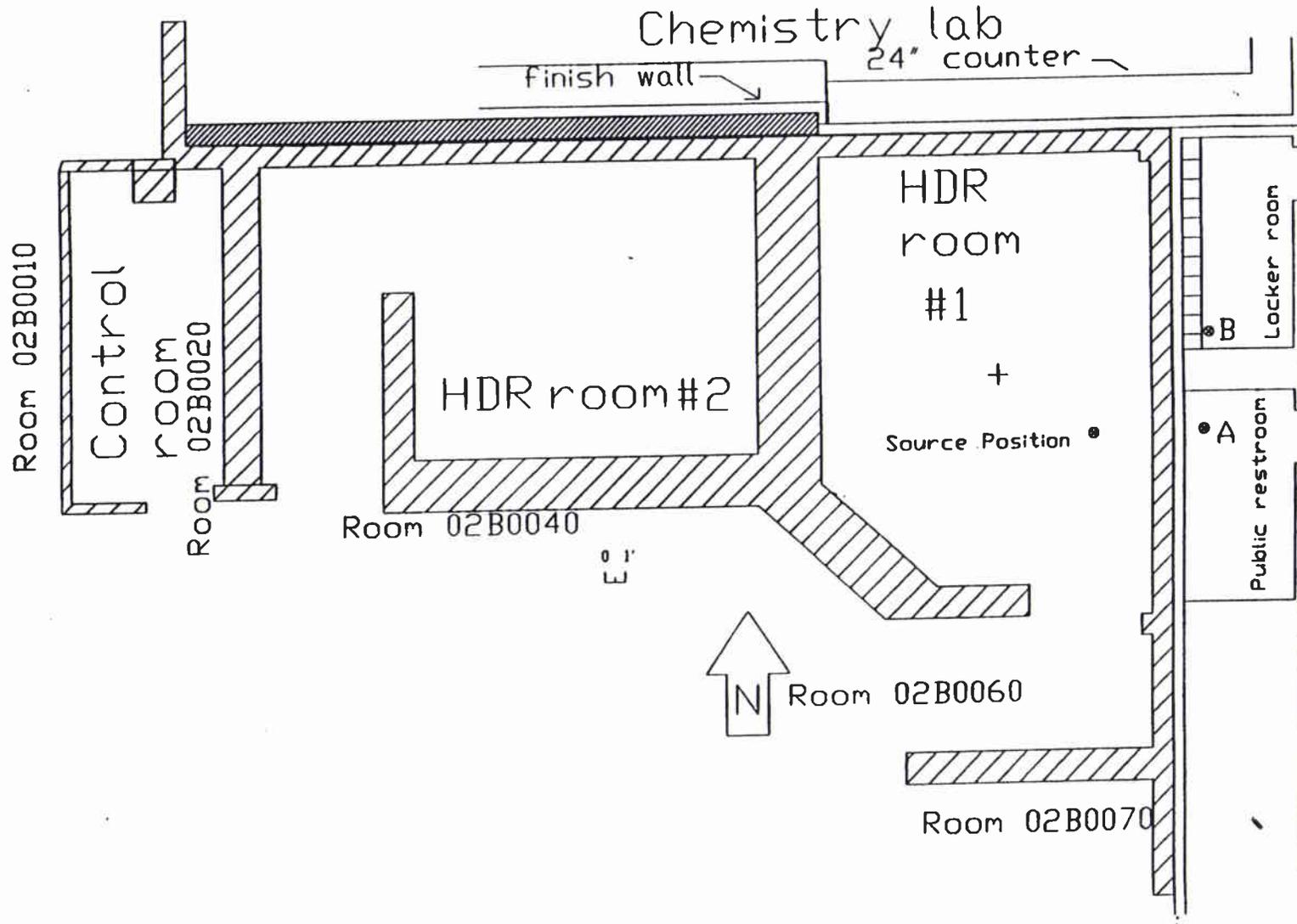
Results:

Room	Maximum Instantaneous Exposure Rate, mR/hr	Exposure Rate Normalized to source activity of 10.0 Ci	Normalized Exposure in any one hour, with maximum "on time" of 20 minutes/hour
public bathroom	1.3	2.3	0.8
locker room	0.65	1.1	0.4

Results: Shielding is determined to be adequate to keep exposure rates in uncontrolled areas within regulatory limits. In practice, the source is never placed near the outside walls. The exposure rate in the chemistry lab would be expected to be much lower, as the source is never used near that end of the treatment room, though the structural details are similar to the locker room and bathroom.

Gregory K. Edmundson, M.Sc
Medical Physicist

APPENDIX B



Beaumont

William Beaumont Hospital
Royal Oak

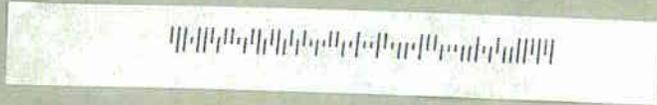
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