



## **ATTACHMENT 02**

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### **SPECIFICATIONS**

**605-19-100**

**13 pages**

**13 July 2018**

**Loma Linda, California VA Health Care System (605)**

**Upgrade HVAC & Led Lining**

**CONSTRUCTION**

## Radiation Protection Shielding Design

**Facility:** VA Loma Linda - Procedure Room

**Address:** 11201 Benton St, Loma Linda, CA 92357

**Contact:** Timothy J. LaFave, PM/COR, Loma Linda VAMC, Timothy.Lafave@va.gov

**Signature:** 

**Room ID:** SSV Procedure Room 3D-72

**Date:** July 13, 2018

**Calculation Method:** NCRP 147

**Installation Type:** Fluoroscopic

**Fluoroscopic Patients / Week:** 30

**Physicist:**

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### Barrier Requirements Summary

<i>Protected Location</i>	<i>Existing Structural Material</i>	<i>Recommended Additional Barrier</i>	<i>P/T (mGy/wk)</i>	<i>Shielded Air Kerma (mGy/wk)</i>
North Wall - Balcony	1.75 in gypsum		0.1	0.0594
North Wall - Glass	0.50 in plate glass		0.1	0.0843
North West Corner - Corridor	1.75 in gypsum		0.1	0.0873
East Wall - Sleep Room	1.25 in gypsum	2 / 64ths inch lead	0.02	0.0123
South Wall - Handwash Station Glass	0.25 in plate glass	1.50 in plate glass	0.1	0.0781
South Wall - Ante Room	1.25 in gypsum	2 / 64ths inch lead	0.1	0.0123
West Wall - Corridor	1.25 in gypsum	2 / 64ths inch lead	0.1	0.0112
Ceiling	3.0 in concrete		0.02	0.0096
Floor	3.0 in concrete		0.02	0.0096

## Comments and Recommendations

1. This is a shielding report for a mobile c-arm procedure room located on the third floor of this multi-story building. A minimum floor-to-floor distance of 12 feet was assumed; a minimum of 2 inches concrete is required in the floor and ceiling. The C-Arm is assumed to expose within a 5 ft by 5 ft box area, centered in the room with a straight line of access to the double doors (marked on diagram). Distance measurements are made from the closest point of the barrier to this box area.
2. All shielding requirements are based on NCRP Report #147 (2005): "Structural Shielding Design and Evaluation for Medical Use of X-Rays." Calculations for each barrier are made using the computer software program based on data and assumptions are from NCRP Report # 147.
3. The following assumptions were used in the shielding calculations:  
Workload: 30 patients per week (240 minutes Fluoro beam on) each room. Assumes 8 minutes fluoro time per patient.
4. Assuming all walls will have the standard 2 layers of 5/8" gypsum board and doors are solid-core.
5. The shielding recommendations are designed to meet Radiation Protection Standards as defined by the VA Code of Radiation Control Regulations. Future changes in either assumed information, equipment, workload, or room design will necessitate a re-evaluation of these shielding requirements
6. This report has been updated as of July 13, 2018, to reflect updated in shielding material thickness for North Wall - Balcony; all previous reports should be disregarded. As confirmed by architectural drawings, the exterior contains a total of 1.75 inches gypsum, among other additional materials; the window is solid plate glass with one inch spandrel insulating panel (estimated equivalent thickness is 0.5 inches).

Protected Location:	<b>North Wall - Balcony</b>							
Design Goal (P) (mGy/wk):	<u>0.02</u>	Occupancy (T):	<u>0.2</u>	P/T (mGy/wk):	<u>0.100</u>	Barrier Type:	<u>Secondary Wall</u>	
Primary or Secondary:	<u>Secondary</u>							
Use Factor:	<u>N/A</u>							
Workload Distribution:	<u>Fluoro (R&amp;F)</u>							
Number of Patients / Week:	<u>30</u>							
Scatter Direction:	<u>Side</u>							
Use Table / Bucky Preshielding? :	<u>N/A</u>							
<b>Under-Table Fluoro Tube</b>								
	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>
Distance to Protected Location:	<u>20.0</u> ft	<u>20.0</u> ft						
Unshielded Air Kerma (mGy/wk):	<u>9.69E-03</u>	<u>2.50E-01</u>						
Other Material Transmission:	<u>1.00E+00</u>	<u>1.00E+00</u>						
Remaining Air Kerma (mGy/wk):	<u>9.69E-03</u>	<u>2.50E-01</u>						
Transmission Model:	<u>Secondary</u>	<u>Secondary</u>						
Preshielding Credit:	<u>N/A</u>							
Existing Material Transmission:	<u>2.29E-01</u>	<u>2.29E-01</u>						
Shielded Air Kerma (mGy/wk):	<u>0.0022</u>	<u>0.0572</u>						
Other Existing Material:			Material: _____					
Structural Material Required:	<u>0.96</u> in	Material: <u>Gypsum</u>						
Existing Structural Material:	<u>1.75</u> in	Material: <u>Gypsum</u>				<b>Shielded Air Kerma (mGy/wk):</b> <u>0.0594</u>		

Protected Location:	<b>North Wall - Glass</b>							
Design Goal (P) (mGy/wk):	<u>0.02</u>	Occupancy (T):	<u>0.2</u>	P/T (mGy/wk):	<u>0.100</u>	Barrier Type:	<u>Secondary Wall</u>	
Primary or Secondary:	<u>Secondary</u>							
Use Factor:	<u>N/A</u>							
Workload Distribution:	<u>Fluoro (R&amp;F)</u>							
Number of Patients / Week:	<u>30</u>							
Scatter Direction:	<u>Side</u>							
Use Table / Bucky Preshielding? :	<u>N/A</u>							
<b>Under-Table Fluoro Tube</b>								
	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>
Distance to Protected Location:	<u>20.0</u> ft	<u>20.0</u> ft						
Unshielded Air Kerma (mGy/wk):	<u>9.69E-03</u>	<u>2.50E-01</u>						
Other Material Transmission:	<u>1.00E+00</u>	<u>1.00E+00</u>						
Remaining Air Kerma (mGy/wk):	<u>9.69E-03</u>	<u>2.50E-01</u>						
Transmission Model:	<u>Secondary</u>	<u>Secondary</u>						
Preshielding Credit:	<u>N/A</u>							
Existing Material Transmission:	<u>3.24E-01</u>	<u>3.24E-01</u>						
Shielded Air Kerma (mGy/wk):	<u>0.0031</u>	<u>0.0811</u>						
Other Existing Material:			Material: _____					
Structural Material Required:	<u>0.41</u> in	Material: <u>Plate Glass</u>						
Existing Structural Material:	<u>0.50</u> in	Material: <u>Plate Glass</u>				<b>Shielded Air Kerma (mGy/wk):</b> <u>0.0843</u>		

Protected Location:	<b>North West Corner - Corridor</b>							
Design Goal (P) (mGy/wk):	<u>0.02</u>	Occupancy (T):	<u>0.2</u>	P/T (mGy/wk):	<u>0.100</u>	Barrier Type:	<u>Secondary Wall</u>	
Primary or Secondary:	<u>Secondary</u>		_____		_____		_____	
Use Factor:	<u>N/A</u>		_____		_____		_____	
Workload Distribution:	<u>Fluoro (R&amp;F)</u>		_____		_____		_____	
Number of Patients / Week:	<u>30</u>		_____		_____		_____	
Scatter Direction:	<u>Side</u>		_____		_____		_____	
Use Table / Bucky Preshielding? :	<u>N/A</u>		_____		_____		_____	
<b>Under-Table Fluoro Tube</b>								
	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>
Distance to Protected Location:	<u>16.5</u> ft	<u>16.5</u> ft	_____	_____	_____	_____	_____	_____
Unshielded Air Kerma (mGy/wk):	<u>1.42E-02</u>	<u>3.68E-01</u>	_____	_____	_____	_____	_____	_____
Other Material Transmission:	<u>1.00E+00</u>	<u>1.00E+00</u>	_____	_____	_____	_____	_____	_____
Remaining Air Kerma (mGy/wk):	<u>1.42E-02</u>	<u>3.68E-01</u>	_____	_____	_____	_____	_____	_____
Transmission Model:	<u>Secondary</u>	<u>Secondary</u>	_____	_____	_____	_____	_____	_____
Preshielding Credit:	<u>N/A</u>		_____		_____		_____	
Existing Material Transmission:	<u>2.29E-01</u>	<u>2.29E-01</u>	_____	_____	_____	_____	_____	_____
Shielded Air Kerma (mGy/wk):	<u>0.0033</u>	<u>0.0840</u>	_____	_____	_____	_____	_____	_____
Other Existing Material:	_____		Material: _____					
Structural Material Required:	<u>1.53</u> in	Material:	<u>Gypsum</u>					
Existing Structural Material:	<u>1.75</u> in	Material:	<u>Gypsum</u>					
					<b>Shielded Air Kerma (mGy/wk):</b> <u>0.0873</u>			

Protected Location:	<b>East Wall - Sleep Room</b>							
Design Goal (P) (mGy/wk):	<u>0.02</u>	Occupancy (T):	<u>1</u>	P/T (mGy/wk):	<u>0.020</u>	Barrier Type:	<u>Secondary Wall</u>	
Primary or Secondary:	<u>Secondary</u>							
Use Factor:	<u>N/A</u>							
Workload Distribution:	<u>Fluoro (R&amp;F)</u>							
Number of Patients / Week:	<u>30</u>							
Scatter Direction:	<u>Side</u>							
Use Table / Bucky Preshielding? :	<u>N/A</u>							
<b>Under-Table Fluoro Tube</b>								
	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>
Distance to Protected Location:	<u>10.0</u> ft	<u>10.0</u> ft						
Unshielded Air Kerma (mGy/wk):	<u>3.88E-02</u>	<u>1.00E+00</u>						
Structural Material Transmission:	<u>6.56E-01</u>	<u>6.56E-01</u>						
Remaining Air Kerma (mGy/wk):	<u>2.54E-02</u>	<u>6.56E-01</u>						
Transmission Model:	<u>Secondary</u>	<u>Secondary</u>						
Preshielding Credit:	<u>N/A</u>							
Rec + Preshield Transmission:	<u>1.80E-02</u>	<u>1.80E-02</u>						
Shielded Air Kerma (mGy/wk):	<u>0.0005</u>	<u>0.0118</u>						
Existing Structural Material:	<u>1.25</u> in	Material:	<u>Gypsum</u>					
Additional Barrier Required:	<u>0.64</u> mm	Material:	<u>Lead</u>					
Recommended Additional Barrier:	<u>0.79</u> mm	Material:	<u>Lead</u> ( 2 / 64ths inch )			<b>Shielded Air Kerma (mGy/wk):</b> <u>0.0123</u>		

Protected Location: South Wall - Handwash Station Glass

Design Goal (P) (mGy/wk): 0.02      Occupancy (T): 0.2      P/T (mGy/wk): 0.100      Barrier Type: Secondary Wall

Primary or Secondary: Secondary

Use Factor: N/A

Workload Distribution: Fluoro (R&F)

Number of Patients / Week: 30

Scatter Direction: Side

Use Table / Bucky Preshielding? : N/A

Under-Table Fluoro Tube

	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>
Distance to Protected Location:	<u>9.0</u> ft	<u>9.0</u> ft						
Unshielded Air Kerma (mGy/wk):	<u>4.78E-02</u>	<u>1.24E+00</u>						
Structural Material Transmission:	<u>7.81E-01</u>	<u>7.81E-01</u>						
Remaining Air Kerma (mGy/wk):	<u>3.74E-02</u>	<u>9.66E-01</u>						
Transmission Model:	<u>Secondary</u>	<u>Secondary</u>						
Preshielding Credit:	<u>N/A</u>							
Rec + Preshield Transmission:	<u>7.79E-02</u>	<u>7.79E-02</u>						
Shielded Air Kerma (mGy/wk):	<u>0.0029</u>	<u>0.0752</u>						

Existing Structural Material: 0.25 in      Material: Plate Glass

Additional Barrier Required: 1.30 in      Material: Plate Glass

Recommended Additional Barrier: 1.50 in      Material: Plate Glass

**Shielded Air Kerma (mGy/wk): 0.0781**



Protected Location:	<b>South Wall - Ante Room</b>							
Design Goal (P) (mGy/wk):	<u>0.02</u>	Occupancy (T):	<u>0.2</u>	P/T (mGy/wk):	<u>0.100</u>	Barrier Type:	<u>Secondary Wall</u>	
Primary or Secondary:	<u>Secondary</u>							
Use Factor:	<u>N/A</u>							
Workload Distribution:	<u>Fluoro (R&amp;F)</u>							
Number of Patients / Week:	<u>30</u>							
Scatter Direction:	<u>Side</u>							
Use Table / Bucky Preshielding? :	<u>N/A</u>							
<b>Under-Table Fluoro Tube</b>								
	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>
Distance to Protected Location:	<u>10.0</u> ft	<u>10.0</u> ft						
Unshielded Air Kerma (mGy/wk):	<u>3.88E-02</u>	<u>1.00E+00</u>						
Structural Material Transmission:	<u>6.56E-01</u>	<u>6.56E-01</u>						
Remaining Air Kerma (mGy/wk):	<u>2.54E-02</u>	<u>6.56E-01</u>						
Transmission Model:	<u>Secondary</u>	<u>Secondary</u>						
Preshielding Credit:	<u>N/A</u>							
Rec + Preshield Transmission:	<u>1.80E-02</u>	<u>1.80E-02</u>						
Shielded Air Kerma (mGy/wk):	<u>0.0005</u>	<u>0.0118</u>						
Existing Structural Material:	<u>1.25</u> in	Material:	<u>Gypsum</u>					
Additional Barrier Required:	<u>0.24</u> mm	Material:	<u>Lead</u>					
Recommended Additional Barrier:	<u>0.79</u> mm	Material:	<u>Lead</u> ( 2 / 64ths inch )			<b>Shielded Air Kerma (mGy/wk):</b> <u>0.0123</u>		

Protected Location:	<b>West Wall - Corridor</b>							
Design Goal (P) (mGy/wk):	<u>0.02</u>	Occupancy (T):	<u>0.2</u>	P/T (mGy/wk):	<u>0.100</u>	Barrier Type:	<u>Secondary Wall</u>	
Primary or Secondary:	<u>Secondary</u>							
Use Factor:	<u>N/A</u>							
Workload Distribution:	<u>Fluoro (R&amp;F)</u>							
Number of Patients / Week:	<u>30</u>							
Scatter Direction:	<u>Side</u>							
Use Table / Bucky Preshielding? :	<u>N/A</u>							
<b>Under-Table Fluoro Tube</b>								
	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>
Distance to Protected Location:	<u>10.5</u> ft	<u>10.5</u> ft						
Unshielded Air Kerma (mGy/wk):	<u>3.51E-02</u>	<u>9.08E-01</u>						
Structural Material Transmission:	<u>6.56E-01</u>	<u>6.56E-01</u>						
Remaining Air Kerma (mGy/wk):	<u>2.30E-02</u>	<u>5.95E-01</u>						
Transmission Model:	<u>Secondary</u>	<u>Secondary</u>						
Preshielding Credit:	<u>N/A</u>							
Rec + Preshield Transmission:	<u>1.80E-02</u>	<u>1.80E-02</u>						
Shielded Air Kerma (mGy/wk):	<u>0.0004</u>	<u>0.0107</u>						
Existing Structural Material:	<u>1.25</u> in	Material:	<u>Gypsum</u>					
Additional Barrier Required:	<u>0.22</u> mm	Material:	<u>Lead</u>					
Recommended Additional Barrier:	<u>0.79</u> mm	Material:	<u>Lead</u> ( 2 / 64ths inch )			<b>Shielded Air Kerma (mGy/wk):</b> <u>0.0112</u>		

Protected Location:	<u>Ceiling</u>							
Design Goal (P) (mGy/wk):	<u>0.02</u>	Occupancy (T):	<u>1</u>	P/T (mGy/wk):	<u>0.020</u>	Barrier Type:	<u>Ceiling</u>	
Primary or Secondary:	<u>Secondary</u>							
Use Factor:	<u>N/A</u>							
Workload Distribution:	<u>Fluoro (R&amp;F)</u>							
Number of Patients / Week:	<u>30</u>							
Scatter Direction:	<u>Fwd/Back</u>							
Use Table / Bucky Preshielding? :	<u>N/A</u>							
<u>Under-Table Fluoro Tube</u>								
	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>
Distance to Protected Location:	<u>12.0</u> ft	<u>12.0</u> ft						
Unshielded Air Kerma (mGy/wk):	<u>2.69E-02</u>	<u>9.87E-01</u>						
Other Material Transmission:	<u>1.00E+00</u>	<u>1.00E+00</u>						
Remaining Air Kerma (mGy/wk):	<u>2.69E-02</u>	<u>9.87E-01</u>						
Transmission Model:	<u>Secondary</u>	<u>Secondary</u>						
Preshielding Credit:	<u>N/A</u>							
Existing Material Transmission:	<u>9.50E-03</u>	<u>9.50E-03</u>						
Shielded Air Kerma (mGy/wk):	<u>0.0003</u>	<u>0.0094</u>						
Other Existing Material:		Material:						
Structural Material Required:	<u>2.34</u> in	Material:	<u>Concrete</u>					
Existing Structural Material:	<u>3.00</u> in	Material:	<u>Concrete</u>					
							<b>Shielded Air Kerma (mGy/wk):</b>	<u>0.0096</u>

Protected Location:	<b>Floor</b>							
Design Goal (P) (mGy/wk):	<u>0.02</u>	Occupancy (T):	<u>1</u>	<b>P/T (mGy/wk):</b>	<u>0.020</u>	Barrier Type:	<u>Secondary Floor</u>	
Primary or Secondary:	<u>Secondary</u>							
Use Factor:	<u>N/A</u>							
Workload Distribution:	<u>Fluoro (R&amp;F)</u>							
Number of Patients / Week:	<u>30</u>							
Scatter Direction:	<u>Fwd/Back</u>							
Use Table / Bucky Preshielding? :	<u>N/A</u>							
<b>Under-Table Fluoro Tube</b>								
	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>	<b>Leakage</b>	<b>Scatter</b>
Distance to Protected Location:	<u>12.0</u> ft	<u>12.0</u> ft						
Unshielded Air Kerma (mGy/wk):	<u>2.69E-02</u>	<u>9.87E-01</u>						
Other Material Transmission:	<u>1.00E+00</u>	<u>1.00E+00</u>						
Remaining Air Kerma (mGy/wk):	<u>2.69E-02</u>	<u>9.87E-01</u>						
Transmission Model:	<u>Secondary</u>	<u>Secondary</u>						
Preshielding Credit:	<u>N/A</u>							
Existing Material Transmission:	<u>9.50E-03</u>	<u>9.50E-03</u>						
Shielded Air Kerma (mGy/wk):	<u>0.0003</u>	<u>0.0094</u>						
Other Existing Material:		Material:						
Structural Material Required:	<u>2.34</u> in	Material:	<u>Concrete</u>					
Existing Structural Material:	<u>3.00</u> in	Material:	<u>Concrete</u>					
						<b>Shielded Air Kerma (mGy/wk):</b>	<u>0.0096</u>	

Balcony - No Occupants within 20 ft

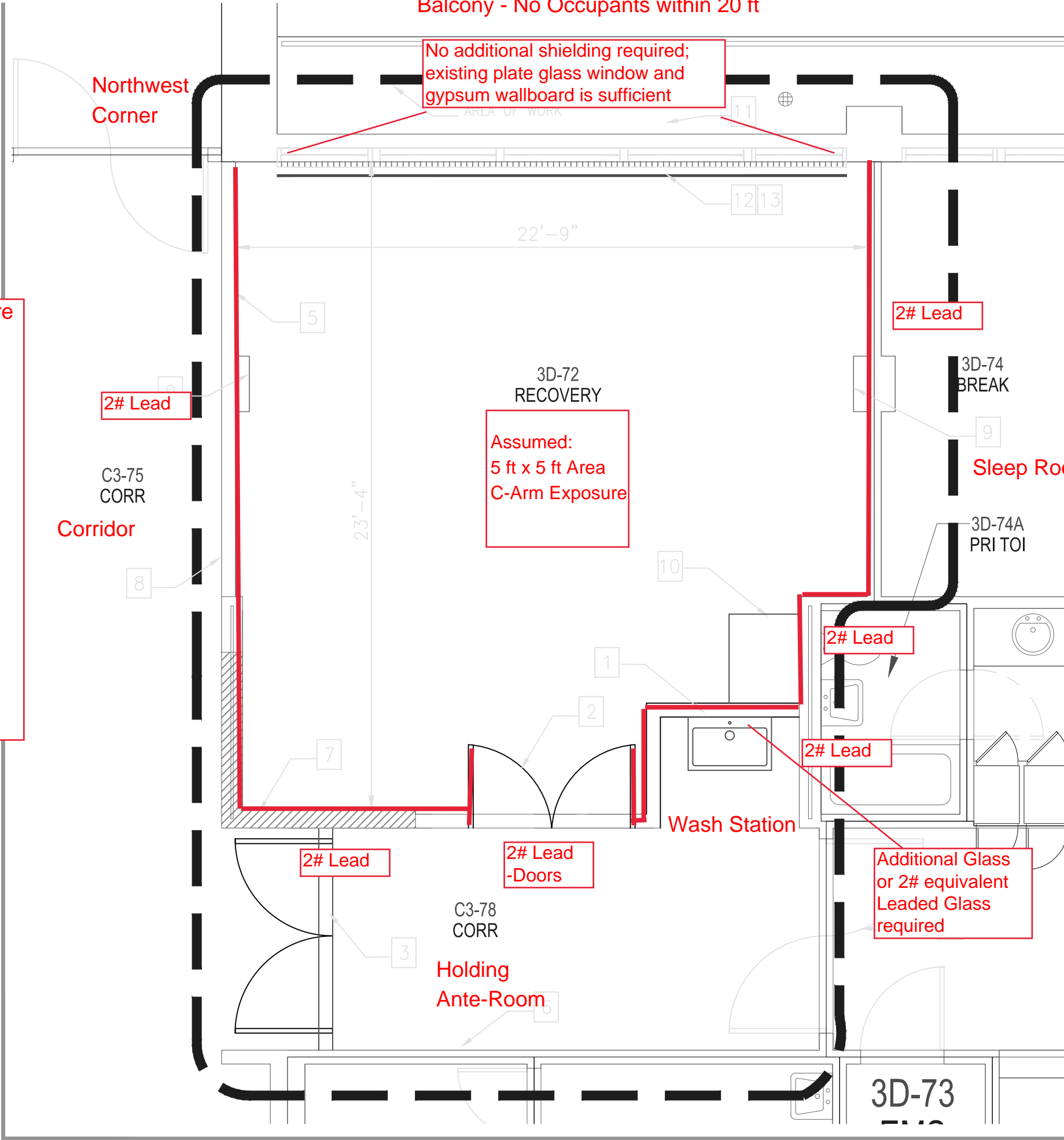
No additional shielding required; existing plate glass window and gypsum wallboard is sufficient

Northwest Corner

Project: VA Loma Linda Procedure Room 3D-72, Mobile C-Arm  
Date: July 13, 2018  
Version 2.0

Assumes:  
-2 hours per week fluoro-on time  
-Mobile C-Arm used within 5x5 ft box centered in room  
-At least 12 ft floor-to-floor height, at least 2 inches concrete in floor and ceiling  
-North Wall contains at least 1.75 inch Gypsum and 0.5 inch plate glass

2# / sq ft lead = 1/32 inch lead



2# Lead

2# Lead

Assumed:  
5 ft x 5 ft Area  
C-Arm Exposure

Corridor

Sleep Room

2# Lead

2# Lead

Additional Glass  
or 2# equivalent  
Leaded Glass  
required

2# Lead

2# Lead  
-Doors

Holding  
Ante-Room

3D-73