

Addendum Issue Date: Tuesday, August 23, 2011

Project Name / Address: **Mary Immaculate Hospital
Nuclear Camera Replacement**
2 Bernadine Drive
Newport News, Virginia 23602

Owner's Name / Address: **Bon Secours Virginia Health System**
5875 Bremo Road, Suite 306
Richmond, Virginia 23226

Construction Documents Issue Date: **March 15, 2011**

Issued To: Prospective Bidders
Owner and Consultants

From: ODELL Associates Inc.
2700 East Cary Street
Richmond, Virginia 23223

Pages / Sheets: This Addendum: 5 pages
Specifications and Letter Size Drawing Attachments: 30 pages
Large Drawing Attachments: 0 sheets

This Addendum forms a part of the Contract Documents and modifies the original Construction Documents and the previously issued Addenda as described below.

Acknowledge receipt of this Addendum in the space provided on the Bid Form. Failure to do so may subject Bidder to disqualification.

Verbal changes or written changes, other than those on an addendum issued by ODELL Associates Inc, are null and void.

Underlined language = Added requirement. *example:* Underline

Strikethrough language = Deleted requirement. *example:* ~~Strikethrough~~

CHANGES TO SPECIFICATIONS:

03 30 00 – CAST IN PLACE CONCRETE

Add: New Section 03 30 00 “Cast-in-place Concrete” in its entirety and which is attached with this addendum

03 54 16 – HYDRAULIC CEMENT UNDERLAYMENT

Add: New Section 03 54 16 “Hydraulic Cement Underlayment” in its entirety and which is attached with this addendum

07 26 10 – UNDER-SLAB VAPOR RETARDERS

Add: New Section 07 26 10 “Under-slab Vapor Retarders” in its entirety and which is attached with this addendum

13 05 13 – PHYSICIST CONSULTANT’S REPORT

Add: Physicist Consultant Report Issued for review and information

RFI QUESTIONS AND ANSWERS:

1. We understand that the intent is for the contractor to consider LEED sensitive products and measures wherever possible – please confirm.

Answer: *As explained at the pre-bid meeting, Bon Secours Virginia is committed to being environmentally conscience on all projects, so the selected firm will be expected to take a proactive and serious approach to any sustainable or environmentally friendly efforts.*

2. The specs include a section for a Unistrut grid system but it does not appear that the equipment necessitates the system. Please confirm if the provisions are required and if the system is required for future equipment, the loading requirements associated with the “future” equipment.

Answer: *No ceiling mounted Unistrut grid system is required for the installation of the proposed GE equipment.*

3. The equipment gantry and table appear to be base-supported. Are we to assume that the existing slab-on-grade is of a suitable thickness to support the new equipment?

Answer: *For pricing purposes, assume the slab is sufficient for the new equipment.*

4. The GE Plans indicate the conduit requirements on E1 with general routing. Are there cable length (outside of those shown on E2) or shielding restrictions that preclude routing conduits in a common trench and/or to the ceiling space and then installing the conduit to the desired devices? This could eliminate unnecessary flooring demolition.

Answer: *A common trench may be used for routing conduits, as long as the maximum cable length specified on the GE Drawings is not exceeded, however, no surface ductwork or trench duct is permissible on this project. The use of under slab conduit as shown on E1 is the best design for this equipment given that requirement. Conduits specified as being routed in the floor must be routed in the floor. Conduits specified as routed above the ceiling shall remain above the ceiling.*

5. Please confirm that GE does not require wiremold raceway for any of the equipment.

Answer: *GE does not require Wiremold raceway for any of the equipment. Electrical Drawings account for any additional conduit required in lieu of raceway.*

6. The GE equipment checklist appears to be from an MRI as it references cryogen venting, RF screening, etc. please confirm that those systems are not a requirement of this project.

Answer: *The equipment checklist on sheet C1 is used for all GE Diagnostic Imaging modalities. Items 1 and 2, and the reference to Unistrut in item 10 do not apply to this project.*

7. The plans and specs require guidance from a radiological physicist for proper lead shielding thicknesses. If the report is unavailable, is there a standard thickness to assume and provide for the limited quantity of new lead shielding?

Answer: *See attached physicist report for required shielding.*

8. GE's customer site readiness list requires the customer to arrange "for any rigging, special handling..." The equipment does not appear to warrant rigging or special handling outside of what GE should provide. Can GE please clarify what assistance, if any, they may need for rigging and handling?

Answer: *For this particular project, no assistance for rigging or handling will be required.*

9. I originally overlooked but have since found the lead shielding thickness in the Radiation Protection section – so that addresses the thickness. However, there are provisions for installation of shielding in concrete floor slabs. Even if the SOG is partially or fully replaced (reference the prior question for the condition of the existing SOG) and there is no basement below this area, there will be no requirement for horizontal shielding? Likewise, since the field is not bi-planar that there will be no shielding overhead?

Answer: *See attached physicist report for required shielding.*

10. It doesn't look like the set of documents include a finish plan or schedule.

Answer: *See attached finish schedule.*

11. SECTION 23 08 00 , Part 1.4 refers to 'ALLOWANCES' in Division 01 and Part 1.6 UNIT PRICES refers to a 'List of Unit Prices' – I do not believe either section is found in the project specifications.

Answer: *Provide a Cx plan with line item cost and hours breakdown for Owner and A/E approval prior to start of Cx work.*

12. Are the demo'd items (casework, lighting, etc.) to be turned over to the Owner or be disposed of?

Answer: *Assume all demolished items are to be turned over to the Owner and confirm with the director of facilities prior to the start of demolition.*

13. There will be a substantial amount of drywall and flooring (saw cut concrete, etc. for trenches) disturbed to provide new electrical conduit. It will be difficult to match the paint and flooring in a manner that will not look like a patch. Please confirm all General Contractors should provide pricing to paint 100% of both the Procedure and Control room. Please confirm that all General Contractors should provide pricing to provide new flooring in the entire Procedure room.

Answer: *See attached finish schedule.*

14. The drawings indicate the ceiling tile should be demo'd, but the ceiling grid should remain in place to be reused. There is a large AHU that is to be installed above the ceiling in this room. The grid

will be damaged if left in place during the installation of the new mechanical equipment and duct work. Please confirm that all General Contractors should provide pricing to provide new ceiling grid.

Answer: *Due to the extent of the mechanical work, the scope of work should include replacement of the ceiling grid in addition to the tiles.*

15. Is it possible for this bid to be submitted by fax as well?

Answer: *All bids are required to be delivered as a hard copy in a sealed envelope to the address listed by the deadline. Any other form of submission will be considered supplemental, but does not take the place of the hard copy submission.*

16. The renovation requires a new under slab conduit to be run to the location of the new equipment. This will require saw cutting and patching of the concrete slab. However, no specifications/details are provided regarding the design of the slab. Please provide required information such as concrete mix design, slab reinforcing details, vapor barrier information, etc.

Answer: *See attached specification sections.*

17. Note D1 on sheet AE101 says to coordinate the removal of the existing medical equipment with the Owner and Vendor. However, who will actually be responsible for removing and disposing of the equipment?

Answer: *The Owner will remove the existing equipment.*

18. Item 63 on sheet A1 (equipment drawings) indicated wall protection. Is this protection currently installed? If not, are we to furnish and install (no specification for wall protection is included)?

Answer: *No wall protection is required.*

19. The drawings indicate an "In Use" light above the procedure room door. Are we reusing an existing fixture? A new fixture is not specified.

Answer: *See attached specification for Lithonia LQM-P-W-1-G-120/277-SW16*

20. Sheet S1 indicates limits for floor flatness and levelness. Does the room meet these requirements now or should all GC's assume that the floor should be self-leveled with an Ardex type system as required by the equipment manufacturer?

Answer: *All GCs should plan on leveling the floor with an Ardex type system to meet GE's floor levelness specifications. (Sheet S2)*

21. Is the door limit switch required (reference A1)? If so, is it to be provided by the electrical subcontractor?

Answer: *Door limit switch is not part of the scope of work.*

22. Is the GC to provide the Hilti anchors and accessories noted on the S2 equipment drawing?

Answer: *GE will provide the Hilti anchors and anchor the system to the floor.*

23. Is the GC to provide the yellow caution tape for the working area indicated on the S2 equipment drawing?

Answer: *GE will provide and install the yellow caution tape indicated on Sheet S2.*

END OF SECTION 00 91 13.1

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture.
- C. Shop Drawings: For steel reinforcement. .

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class C or F.
- B. Normal-Weight Aggregates: ASTM C 33, graded, 3/4-inch nominal maximum coarse-aggregate size.
 - 1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.

2.4 VAPOR RETARDERS

- A. Comply with requirements in Section 07 26 10 "Under-Slab Vapor Retarders".

2.5 CURING MATERIALS

- A. Water: Potable.
- B. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

2.7 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

- B. Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 3500 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.50.
 3. Slump Limit: 4 inches, plus or minus 1 inch.
 4. Air Content: 5-1/2 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
 5. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.

2.8 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork according to ACI 301 to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR RETARDERS

- A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
- B. Comply with Section 07 26 10 "Under-Slab Vapor Retarders".

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- C. Cold-Weather Placement: Comply with ACI 306.1.
- D. Hot-Weather Placement: Comply with ACI 301.

3.7 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to view.

- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to view, to be covered with a coating or covering material applied directly to concrete.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces.
 - 1. Apply scratch finish to surfaces to receive concrete floor toppings.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing.
- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, paint, or another thin-film-finish coating system.
 - 2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-foot- long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/8 inch
- D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

3.9 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.

2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

3.10 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

3.11 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
 1. Testing Services: Tests shall be performed according to ACI 301.

END OF SECTION 03 30 00

SECTION 035416 - HYDRAULIC CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes hydraulic-cement-based, polymer-modified, self-leveling underlayment for application below interior floor coverings.
- B. Related Sections:
 - 1. Division 09 Sections for patching and leveling compounds applied with floor coverings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Sustainability Submittals:
 - 1. Product Data: For priming and sealing coatings, documentation including printed statement of VOC content.
- C. Shop Drawings: Include plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: Signed by manufacturers of underlayment and floor-covering systems certifying that products are compatible.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.
- B. Product Compatibility: Manufacturers of underlayment and floor-covering systems certify in writing that products are compatible.
- C. Fire-Resistance Ratings: Where indicated, provide hydraulic-cement underlayment systems identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

- D. Sound Transmission Characteristics: Where indicated, provide hydraulic-cement underlayment systems identical to those of assemblies tested for STC and IIC ratings per ASTM E 90 and ASTM E 492 by a qualified testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.
 - 1. Place hydraulic-cement-based underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F.

1.7 COORDINATION

- A. Coordinate application of underlayment with requirements of floor-covering products and adhesives, specified in Division 09 Sections, to ensure compatibility of products.

PART 2 - PRODUCTS

2.1 HYDRAULIC-CEMENT-BASED UNDERLAYMENTS

- A. Underlayment: Hydraulic-cement-based, polymer-modified, self-leveling product that can be applied in minimum uniform thickness of 1/4 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Products: Subject to compliance with requirement provide one of the following:
 - a. Ardex; K-15 Self-Leveling Underlayment Concrete.
 - b. BASF Construction Chemicals, Inc.; MBT Mastertop 110 Plus Underlayment.
 - c. Euclid Chemical Company (The); Level Magic.
 - d. L&M Construction Chemicals, Inc.; Levelex.
 - e. MAPEI Corporation; Novoplan 2, Ultraplan 1 Plus.
 - f. Maxxon Corporation; Level-Right.
 - g. Specialty Construction Brands, Inc., an H.B. Fuller company; TEC EZ Level.
 - 2. Cement Binder: ASTM C 150, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.
 - 3. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C 109/C 109M.
 - 4. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer, formulated for use with underlayment when applied to substrate and conditions indicated.

- B. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch; or coarse sand as recommended by underlayment manufacturer.
 - 1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.
- C. Water: Potable and at a temperature of not more than 70 deg F.
- D. Reinforcement: For underlayment applied to wood substrates, provide galvanized metal lath or other corrosion-resistant reinforcement recommended in writing by underlayment manufacturer.
- E. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.
 - 1. Primer shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D.
- F. Corrosion-Resistant Coating: Recommended in writing by underlayment manufacturer for metal substrates.
 - 1. Coating shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for conditions affecting performance.
 - 1. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Prepare and clean substrate according to manufacturer's written instructions.
 - 1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
 - 2. Fill substrate voids to prevent underlayment from leaking.
- B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.
 - 1. Moisture Testing: Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of required by the hydraulic cement underlayment manufacturer.
- C. Metal Substrates: Mechanically remove, according to manufacturer's written instructions, rust, foreign matter, and other contaminants that might impair underlayment bond. Apply corrosion-resistant coating compatible with underlayment if recommended in writing by underlayment manufacturer.

- D. Nonporous Substrates: For ceramic tile, quarry tile, and terrazzo substrates, remove waxes, sealants, and other contaminants that might impair underlayment bond, and prepare surfaces according to manufacturer's written instructions.
- E. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

3.3 APPLICATION

- A. General: Mix and apply underlayment components according to manufacturer's written instructions.
 - 1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
 - 2. Coordinate application of components to provide optimum underlayment-to-substrate and intercoat adhesion.
 - 3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Apply underlayment to produce uniform, level surface.
 - 1. Apply a final layer without aggregate to product surface.
 - 2. Feather edges to match adjacent floor elevations.
- D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.
- E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.
- F. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 PROTECTION

- A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION 03 54 16

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Vapor retarder, seam tape, pipe boots, detail strip, for installation directly under concrete slabs on grade.

1.2 RELATED SECTIONS

- A. Section 03 30 00 – Cast-in-Place Concrete: For slab on grade requirements.

1.3 REFERENCES

- A. ASTM International:
 1. ASTM E 96 “Standard Test Methods for Water Transmission of Materials”.
 2. ASTM E 154 “Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Covers.
 3. ASTM E 1745 “Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs”.
 4. ASTM E 1643 “Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs”.

1.4 ACTION SUBMITTALS

- A. Product Data: For each product indicated.
- B. Samples:
 1. Sheet Materials: Two, 11 by 8-1/2 inches, with vapor retarder manufacturer's product description label affixed.
 2. Seam Tape: Two, 11 inch long with backing affixed over adhesive, with vapor retarder manufacturer's product description label affixed.

1.5 INFORMATIONAL SUBMITTALS

- A. Independent laboratory test results showing compliance with ASTM and ACI Standards.

1.6 QUALITY ASSURANCE

- A. Obtain vapor retarder membrane and seam tape from the same manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Description: Provide extremely low permeance vapor retarder for placement under concrete slabs on grade, meeting the following:

1. Permeance:

- a. ASTM E 96 or ASTM E 154: 0.02 to 0.09 perms.
- b. ASTM F 1249: 0.0067 to 0.0084 perms.

B. Physical Requirements: Provide vapor retarder products meeting the following:

1. Water Vapor Retarder: ASTM E 1745, Class A.

2.2 MANUFACTURERS

A. For use between stable substrates and concrete slab and subject to compliance with the requirements, provide one of the following products:

1. Stego Wrap 15 mil Vapor Barrier; Stego Industries LLC, San Juan Capistrano, California 92675; 877 464 7834 (polyolefin).
2. VaporBlock 15 Underslab Vapor Retarder; Raven Industries, Sioux Falls, South Dakota 57104; 800 635 3456 (polyolefin).
3. Moistop Ultra "A" 15 mil; Fortifiber Building Products Systems, Reno, Nevada 89509; 800 773 4777 (polyolefin).
4. Griffolyn 15 Mil Green; Reef Industries, Inc., Houston, Texas 77275; 800 231 6074 (polyolefin).
5. Preprufe 160R; Grace Construction Products, Cambridge, Massachusetts 02140; 866 333 3726 (HDPE).
6. Barrier-Bak VB-350 16 mil Vapor Barrier; Intoplast Group, Ltd. Livingston, New Jersey; 973 994 8000 (polyolefin).
7. Viper II 15 mil; Insulation Solutions Inc., East Peoria, Illinois 61611; 866 698 6562 (polyolefin).

B. For use between void formed slabs and concrete slab and subject to compliance with the requirements, provide one of the following products:

1. Barrier-Bac IntePlus XF Film VBC 250, 26 mil, Composite Vapor Retarder; Intoplast Group, Livingston, New Jersey, 800 452 2117.
2. Florprufe 120; Grace Construction Products, Cambridge, Massachusetts 02140; 866 333 3726 (polyolefin).

2.3 ACCESSORIES

A. Seam Tape: High density polyethylene tape with pressure sensitive adhesive. Minimum width four (4) inches.

1. Color: Contrast to color of vapor retarder.

- B. Pipe Boots: Construct pipe boots from vapor retarder material and pressure sensitive tape in accordance with vapor retarder manufacturer's published instructions.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Stable Substrates: Tamp or roll aggregate, sand, or earth base, level.
- B. Void Forms: Ensure that void forms are installed in accordance with void form manufacturer's published instructions.

3.2 INSTALLATION

- A. Locate vapor retarder membrane system directly beneath concrete slab.
- B. Install in accordance with vapor retarder manufacturer's published instructions and ASTM E 1643.
 - 1. Unroll vapor retarder with the longest dimension parallel with the direction of the concrete casting.
 - 2. Lap vapor retarder over footings and seal to foundation walls.
 - 3. Overlap joints six (6) inches and seal with vapor retarder manufacturer's seam tape.
 - 4. Seal penetrations, including but not limited to pipes, conduits, and reinforcement, with pipe boots and tape.
 - 5. Ensure that there are no penetrations of the vapor retarder except for permanent utilities and reinforcement.
 - 6. Install pressure sensitive adhesive type with adhesive facing upward contacting concrete slab.
- C. Repair damaged areas by cutting patches of vapor retarder, overlapping damaged area six (6) inches all around and taping all sides or entire perimeter with seam tape.

END OF SECTION 07 26 10



FINISH SCHEDULE

Project: Mary Immaculate Nuclear Camera Replacement

ROOM #	ROOM NAME	FLOOR	BASE	TRIM	WALLS	CASEWORK	COUNTERTOP	CEILING
1B141	EXISTING NUCLEAR EXAM ROOM	SV1	SVB1	PT1	PT2	PL1	PL2	ACP1
1B141A	EXISTING CONTROL ROOM	SV1	SVB1	PT1	PT2	PL1	PL2	ACP1

FINISH TYPE	SELECTION NUMBER	FINISH	MANUFACTURER	COLOR/PATTERN	REMARKS
FLOORING					
SV	1	SHEET VINYL	MANNINGTON BIOSPEC	15103 SANDRIFT	
WR	1	WELD ROD		TO BE SELECTED BY ARCHITECT	
SVB	1	INTEGRAL BASE		6" TO MATCH FLOORING	
WALLS					
PT	1	PAINT (TRIM)	SHERWIN WILLIAMS	SW 6385 DOVER WHITE	EPOXY COATING
PT	2	PAINT	SHERWIN WILLIAMS	SW 6387 COMPATIBLE CREAM	EPOXY COATING
MILLWORK					
PL	1	PLASTIC LAMINATE	WILSONART	7942K-07 COCOBALA	
PL	2	PLASTIC LAMINATE	ARBORITE	P-312 FP GREEN XABIA	

CEILING					
APC	1	ACOUSTICAL CEILING	ARMSTRONG	CLEAN ROOM VL APC CELING	GASKETED SYSTEM, 2X2 ALUM GRID
MISCELLANEOUS					
CG	1	CORNER GUARD	ACROVYN	CO-8 STAINLESS STEEL	3 ½", FULL HEIGHT, ADHESIVE MOUNTING

DOORS

WOOD DOOR WD-1 : MATCH SPECIES AND STAIN OF HOSPITAL STANDARD

HEALTH PHYSICS CONSULTATION

Providing professional radiation physics services since 1964

ROY F. HELTZEL, JR., DABR
ROBERT T. MAY, CHP
PAUL T. SUTCLIFFE

637 KINGSBOROUGH SQUARE, SUITE A
CHESAPEAKE, VA 23320-4944
PHONE (757) 410-9051
FAX (757) 410-9052

December 6, 2010

Thomas Lane
Director of Imaging Services
Mary Immaculate Hospital
2 Bernardine Drive
Newport News, VA 23602

Reference: Shielding Recommendation

Dear Mr. Lane:

Enclosed you will find the completed recommendation for protective x-ray barrier design for the GE Infinia Hawkeye IV nuclear medicine camera as requested. You are required to maintain this report on file for future reference by agency inspectors.

Virginia regulations require that an initial inspection by a qualified inspector be requested no later than 30 days after installation. Please notify us when your installation is completed so that we may schedule the required inspection. Additionally, the application for registration must be submitted to the State within 30 days after initial operation of the equipment.

Should you have any questions, please do not hesitate to contact me. We thank you for this opportunity to be of service.

Sincerely,



Roy F. Heltzel, Jr.
Health Physicist

Enclosures

c: Jessica Thomas, CNMT
Lead Nuclear Medicine Technologist

**RECOMMENDATIONS
PROTECTIVE X-RAY BARRIERS**

PREPARED FOR

Mary Immaculate Hospital
2 Bernardine Drive
Newport News, VA 23602

December 6, 2010

GE Infinia Hawkeye IV Nuclear Medicine Camera

PREPARED BY

HEALTH PHYSICS CONSULTATION
637 Kingsborough Square, Suite A ♦ Chesapeake, VA 23320-4944
(757) 410-9051

Introduction

The format of this report is arranged in the following manner:

1. A summary of the shielding design in general.
2. The design for a specific room followed by the floor plan for that room.
3. In conclusion, the general design criteria is detailed.

DESIGN SUMMARY

Shielding is required to protect those persons working adjacent to x-ray rooms. Lead which offers special shielding properties at medical x-ray energies is the preferred and most used material.

WALLS

All diagnostic shielding walls require the shielding to extend from the floor to at least 7 feet above the floor. The doors and windows in them are required to be of equivalent shielding in all cases. That is, when a wall requires 1/16 inch lead shielding, a door or window installed in that wall is also required to have shielding equivalent to 1/16 inch of lead. Particular attending must be given to the construction of all joints and where penetrations occur.

FLOORS AND CEILINGS

In this design, the existing concrete slab for floors and ceilings provides adequate shielding so that no additional lead will be required.

CONTROL BOOTH

The control booth is designed to maximize the protection of the operator while providing the operator the most advantageous view of the room. In all cases, the control switch MUST BE POSITIONED AT LEAST 40 INCHES FROM THE OUTSIDE EDGE OF THE CONTROL BOOTH.

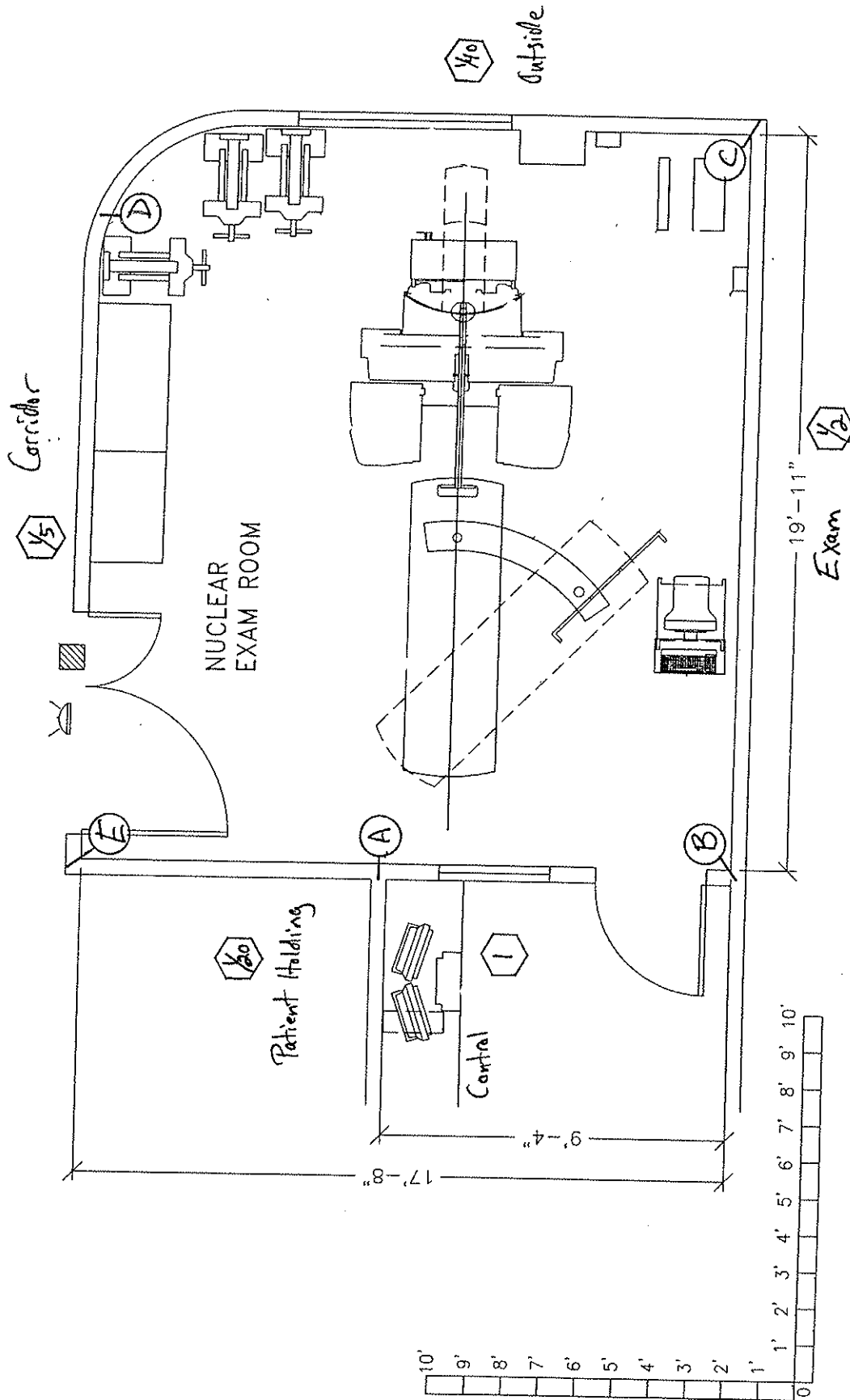
Facility	Mary Immaculate Hospital
Generator	140 kVp, 25 mA – GE Infinia Hawkeye IV Nuclear Medicine Camera
Workload	60 patients/week

Shielding Section	Barrier Type	Minimum Barrier Thickness	Remarks
Wall A-B	S	No shielding required	
Wall B-C	S	No shielding required	
Wall C-D	S	No shielding required	
Wall D-E	S	No shielding required	
Wall E-A	S	No shielding required	
Floor	S	No shielding required	
Ceiling	S	No shielding required	

"P" = Primary; "S" = Secondary

NOTE:

Shielding specified is minimum required and in addition to one sheet of 5/8 inch gypsum wallboard finishing all interior walls. Facility designers may INCREASE shielding thickness for structural or cost purposes.



PRELIMINARY PLANNING ONLY

PROJECT TITLE:

MARY IMMACULATE HOSPITAL
 INFANIA HAWKEYE IV
 NEWPORT NEWS, VIRGINIA

SCHEME NO.: 10BED092 DRAWN BY: DMS DATE: 10/11/10

⬡ = Occupancy Factor

THIS LAYOUT MUST BE APPROVED BEFORE
 FINAL DRAWINGS CAN BE STARTED. THANK YOU

CUSTOMER _____ DATE: _____
 GE INSTALL. SPECIALIST _____ DATE: _____



GE Healthcare

Modality Installation Planning

Milwaukee, Wisconsin

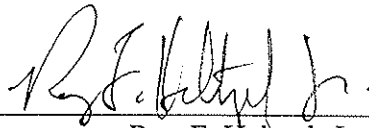
MODIFICATIONS

Health Physics Consultation provides no warranty for these calculations and assumes no liability for any reason if there is any change in the design specifications or if actual usage of this x-ray unit is different from assumptions set forth in this report. No change should be made without first consulting with the Health Physicist at Health Physics Consultation.

CONCLUSION

A copy of this report should be kept on file for future reference by both the owner and regulatory authorities.

The owner and the building contractor must review carefully the contents of this report. If there are any questions or changes to the assumptions or specifications, please notify this Consultant.



Roy F. Heltzel, Jr., DABR
Certified in Diagnostic Radiologic Physics
by the American Board of Radiology

Design Criterion and Assumptions

ROOM ARRANGEMENT

The room arrangement is as shown in the attached, scaled drawing provided by Hospital.

PROTECTIVE BARRIERS

1. Primary: The assumption is made that the floor, the wall behind the upright bucky and the imaging system are sufficient to attenuate the useful beam to the required degree and, therefore, are the primary barriers.
2. Secondary: All walls and the doors and windows in them are considered to be secondary barriers.

USE FACTOR (U)

The fraction of the time that the radiation under consideration is directed at a particular barrier is defined as beam direction factor or "use factor" and is designated as (U). The (U) is assumed to be 0.89 for the floor and 1.0 for the upright bucky, 0.09 for the cross table wall and 0.02 for any other wall.

WORKLOAD (W)

Workload or (W) represents the degree of use of any x-ray unit. The units of (W) are mA min/week.

OCCUPANCY FACTOR (T)

As established by NCRP147: The factor by which the workload is multiplied to correct for the degree of occupancy of the area in question while the unit is operating is defined as "occupancy factor" or (T).

It is assumed that the occupancy factor of:

1. All work areas is 100% (T=1)
2. Corridors is 20% (T=0.20)
3. Storage areas, sidewalks, all outside walls and parking lots is 2.5% (T=0.025)

LEAKAGE X-RAYS

This includes all radiation coming from within the source or tube housing except the useful beam.

The assumption is made that the tube x-ray leakage will not be greater than 100 mR/hr at 1 meter for the maximum continuous rated current for the unit. The beam quality is assumed to be the same as the primary beam.

PHYSICS

It is assumed the exposure rate follows the inverse square law. The scattered radiation is found in the NCRP147 Table 4.7.

FIELD SIZE (F)

The normal x-ray field size is assumed to be 1,000 square centimeters. This is slightly larger than a 12 inch by 12 inch cassette.

EXPOSURE LIMITS

Typical background radiation exposure is 100 millirems annually. Following are the regulated exposure limits.

1. Maximum permissible dose for nonoccupationally exposed individuals is 100 millirems annually.
2. Maximum permissible dose for occupationally exposed individuals is 5,000 millirems annually.
3. ALARA requires exposure to be maintained as far below the limits stated in 1. and 2. as is reasonable.

DISTANCE

The distances used to calculate the protective barriers are measured from the provided drawing. When calculating exposure rates for primary and leakage radiation, the shortest expected distance from the tube to a point one foot beyond the barrier under consideration is used. When calculating exposure rates for scattered radiation, the shortest expected distance from the patient to a point one foot beyond the barrier under consideration is used.

It is assumed that the distance from the patient and the tube target is 1.0 meters for all table radiographic exposures and 1.8 meters for all vertical bucky radiographic exposures.

Specifications - Barrier Construction

MATERIALS

Lead:

Lead shall be of the type specifically designed for shielding purposes. All lead will be handled in a manner which will minimize damage to its surface. Should the need arise, a soft-headed hammer is to be used to flatten a bent area.

All sheet lead shall be bonded to or covered with some form of wallboard that is at least 5/8 inch thick.

Concrete:

The radiation attenuation of a concrete barrier depends upon its thickness, density and composition. Unless otherwise specified, all concrete must have a minimum density of 147 pounds/ft³.

Common cinder blocks must have a density of 60 pounds/ft³. Mortar having a density not less than that of the block is to be used in protective barriers of block construction.

Glass:

Plate glass may be used for observation windows where desired so long as it maintains the required protection equivalency of the barrier into which it is installed.

BARRIERS

Walls:

Lead in the walls is to be installed in a way that will keep the lead from "cold flowing" under its own weight. The lead may be nailed in place, but care must be exercised to avoid sagging that results if the spacing between nails is too great. The principal disadvantages of sheet lead are its not being self-supporting and its being easily damaged. For these reasons, the sheet lead should be covered with some form of wallboard.

Where the edges of two lead sheets meet, continuity of shielding shall be ensured at the joints by sufficiently overlapping the lead sheets not less than 1/2 inch or by the use of a cover strip over butt joints. Nail holes that may result in significant radiation leaks shall be covered with supplementary lead.

All barrier penetrations such as pipes, air ducts, conduits, service boxes, etc., require the use of either lead baffles or lead backing with sufficient overlap in order to regain the integrity of the barrier.

Shielding shall extend from the floor to a height of at least seven feet unless otherwise stated.

View windows shall have a lead equivalency at least equal to that required of the barrier wall or partition into which it is installed.

Doors:

Doors and the door frames and jams shall maintain the same shielding integrity as the barrier into which they are installed, unless specified differently.

Junctions between door frames and adjoining barriers shall be constructed using a 1/2 inch overlap in the same manner as junctions between sheet lead. If this is not done, additional lead shielding must be used to restore the shielding integrity of the barrier.

Doors shall be installed so that the bottom edge comes as close as possible to the finished floor with no more than a 1/2 inch clearance. With a clearance greater than 1/2 inch, a shielded threshold shall be installed.

When standard steel doors have been specified, the door frames must be constructed so as to maintain the equivalent or greater shielding efficiency as the barrier into which it is installed.

Windows:

Every control booth shall have a minimum of one viewing window with an area of at least one square foot and the bottom edge located no higher than 54 inches above the finished floor unless otherwise specified.

Windows shall be located so the operator can view the patient as well as any door into the room. If viewing of all doors can not be done, the doors should be interlocked with the exposure switch to prevent exposure by a door being opened untimely.

The viewing window shall have a lead equivalent at least equal to that required of the barrier in which it is installed.

The distance between the outside edge of the observation window and the edge of the control partition shall not be less than 18 inches except when the whole partition is constructed totally of a viewing material.

Window frames shall give the same protection as the window itself. For either the leaded glass or leaded acrylic window, the lead in the partition must overlap the window frame substantially.

Control Booth:

The operator shall have at least 7.5 square feet of unobstructed floor space. The perimeter of the operator's floor space is to be out of the line-of-sight from the open edge of the booth to any part of the examination table or to a point not closer than one foot from the upright cassette holder.

The x-ray control switch shall be fixed within the control booth so that it is at least 40 inches from any open edge of the booth nearest either the examining table or the upright cassette. The control switch shall also be located so that the operator has use of the major portion of the viewing area. The intention is to provide the operator with maximum barrier protection in all circumstances.

Calculation of Barrier Requirements

All equations used to calculate barrier requirements come from NCRP147

EQUATION FOR PRIMARY PROTECTIVE BARRIER

The equation used to calculate the shielding required for the primary barrier is as follows:

$$B_p (X_{\text{barrier}} + X_{\text{pre}}) = \left(\frac{P}{T} \right) \frac{d_p^2}{k_p^1 UN}$$

B_p = the primary barrier transmission factor

P = weekly shielding design goal

d_p = distance from the source to the location of the maximally exposed individual beyond the primary barrier

K_p^1 = the unshielded primary air kerma per patient at one meter

N = the average number of patients per week

Factors U and T have been defined previously.

EQUATION FOR SECONDARY PROTECTIVE BARRIER

The equation used to calculate the shielding required for the secondary protective barrier from leakage radiation is as follows:

$$B_{\text{sec}}(X_{\text{barrier}}) = \left(\frac{P}{T} \right) \frac{d_{\text{sec}}^2}{K_{\text{sec}}^1 N}$$

P = weekly shielding design goal

d_{sec} = distance from the source to the location of the maximally exposed individual beyond the secondary barrier

B_{sec} = the secondary barrier transmission factor

K_{sec}^1 = the unshielded secondary air kerma per patient at one meter

All other factors have been defined previously.

Design References

1. NCRP34 National Council on Radiation Protection and Measurements, "Medical X-Ray and Gamma-Ray Protection for Energies Up to 10 MeV - Structural Shielding Design and Evaluation", NCRP Report No. 34, 1970, Washington, D.C.
2. NCRP35 National Council on Radiation Protection and Measurements, "Dental X-Ray Protection", NCRP Report No. 35, March, 1970, Washington, D.C.
3. NCRP49 National Council on Radiation Protection and Measurements, "Structural Shielding Design and Evaluation for Medical use of X-Rays and Gamma-Rays of Energies Up to 10 MeV", NCRP Report No. 49, September, 1976, Washington, D.C.
4. Tr.74 Trout E.D., Kelly J.P., and Herbert G.L., July, 1975, "X-Ray Attenuation in Steel - 50 to 300 kVp", Health Physics Vol. 29, pp. 163-169.
5. Tr.75 Trout E.D., Kelly J.P., and Larson V.L., "The Use of Plate Glass as Shielding Material in Diagnostic Radiologic Installation", September, 1974, The Journal of the Canadian Association of Radiologists, Vol. 25 pp 173-177.
6. CRC85 "CRC Handbook of Chemistry and Physics" 65th Edition, 1984-1985, Boca Raton, Florida.
7. Pa81 Packard R.T., 1981 "Ramsey/Sleeper Architectural Graphics Standards" The American Institute of Architects (New York: John Wiley & Sons, Inc.)
8. G179 Gaza S.A., Schneiders N.J., and Bushong S.C., May 1979, "Use of Gypsum Wallboard for Diagnostic X-Ray Protection Barriers", Health Physics Vol. 36, pp. 587-593.
9. Ar83 Archer B.R., Thornby J.I., and Bushong S.C., May 1983, "Diagnostic X-Ray Shielding Design Based on an Empirical Model of Photon Attenuation", Health Physics Vol. 44, pp. 507-517.
10. Archer, B.R., Fewell, T.R., Conway, B.J., and Quinn, P. W., 1994, "Attenuation Properties Of Diagnostic X-Ray Shielding Materials", Med Physics 21, pp. 1499-1507.
11. Dixon, R. L., "On the Primary Barrier in Diagnostic X-Ray Shielding", 1994, Med Physics 21, pp. 1785-1794.
12. Dixon, R. L., and Simpkin, D. J., "Primary Shielding Barriers for Diagnostic X-Ray Facilities: A New Model", 1998, Health Phys 74, pp. 181-189

13. National Council on Radiation Protection and Measurements. Limitations Of Exposure To Ionizing Radiations, 1993, Bethesda, MD: NCRP, NCRP Report No. 116.
14. Simpkin, D. J., "Shielding Requirements for Mammography", 1987, Health Physics 53, pp. 267-279
15. Simpkin, D. J., "Shielding a Spectrum of Workloads in Diagnostic Radiology", 1991, Health Phys 61, pp. 259-266
16. Simpkin, D. J., "Diagnostic X-Ray Shielding Calculations for Effective Dose Equivalents (abs)", 1994, Med Phys
17. Simpkin, D. J., "Transmission Data for Shielding Diagnostic X-Ray Facilities", 1995, Health Phys 68, pp. 704-709
18. Simpkin, D. J., "RSNA Categorical Course in Physics 1995; Physical and Technical Aspects of Interventional Radiology – Regulations and Standards – Radiation Protection". RSNA, Oak Brook, Illinois 1995
19. Simpkin, D. J., "Scatter Radiation Intensities About Mammography Units", 1996, Health Phys 70, pp. 238-245
20. Simpkin, D. J., "Evaluation of NCRP Report 49 Assumptions on Workloads and Use Factors in Diagnostic Radiology Facilities", 1996, Med Physics 23, pp. 577-584
21. Simpkin, D. J. and Dixon, R. L., "Secondary Barriers for Diagnostic X-Ray Facilities: Scatter and Leakage Revisited", 1998, Health Phys 74, pp. 350-365
22. Trout, E.D., and Kelly, J. P., "Scattered Radiation from a Tissue-Equivalent Phantom for X-Rays from 50 to 300 kVp", 1972, Radiology 104, pp. 161-169
23. National Council on Radiation Protection and Measurements. Structural Shielding Design for Medical X-Ray Imaging Facilities, 2004, Bethesda, MD: NCRP, NCRP Report No. 147.

Catalog Number	
Notes	Type

APPLICATION GUIDE: STANDARD SPECIAL SIGNAGE

Lithonia Lighting offers special signage signs to suit many applications. The Signature and Quantum families highlighted below are illuminated with energy-efficient, long-life Light Emitting Diodes (LEDs).



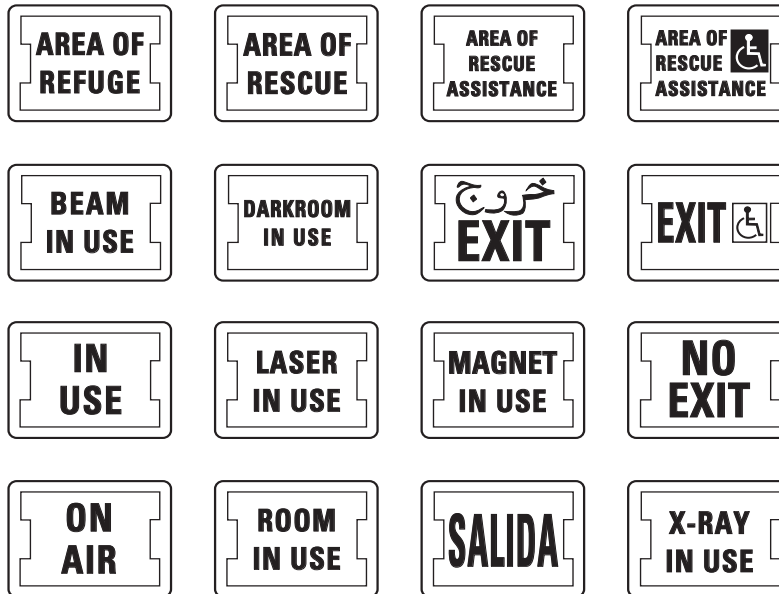
Signature



Quantum



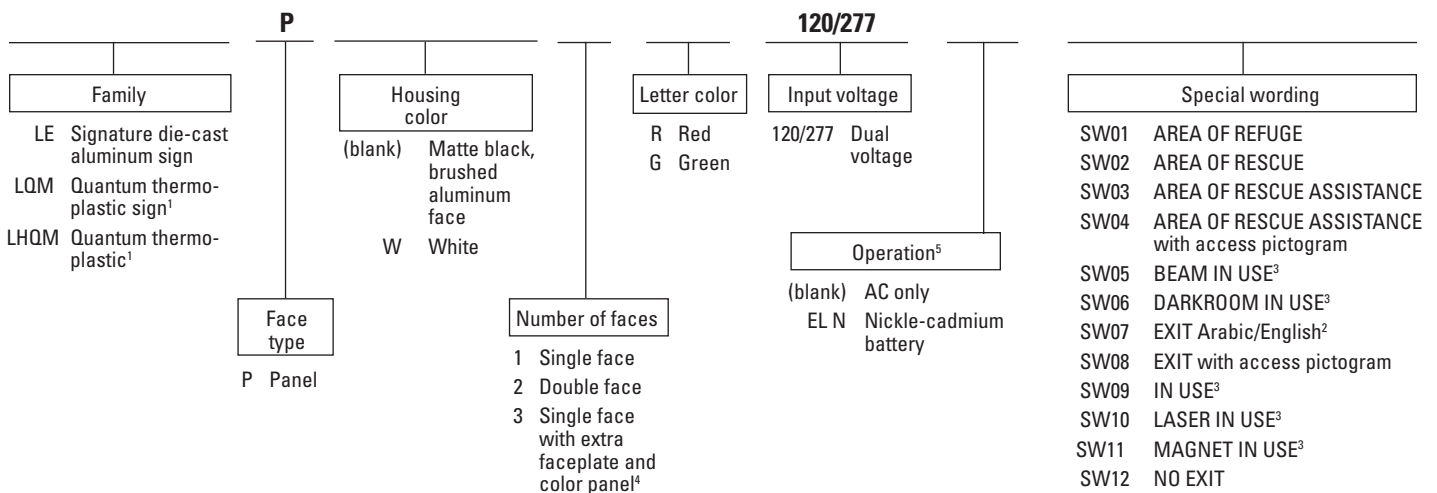
Quantum



ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

Example: LE P 1 R 120/277 EL N SW02



Notes:

- 1 Only available in white housing.
- 2 Only available in red letter color.
- 3 Not available with LHQM family or EL N operation.
- 4 Only available with LQM or LHQM family.
- 5 Leave blank for LHQM family.

CUSTOM SIGNAGE

MAINTENANCE

All life safety equipment, including emergency lighting for path of egress must be maintained, serviced, and tested in accordance with all National Fire Protection Association (NFPA) and local codes. Failure to perform the required maintenance, service, or testing could jeopardize the safety of occupants and will void all warranties.