



KAUAI VETERANS MEMORIAL HOSPITAL
PO Box 337, Waimea, HI 96796
(808) 338-9431

HAWAII HEALTH SYSTEMS CORPORATION
KAUAI REGION
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SAMUEL MAHELONA MEMORIAL HOSPITAL
4800 Kawaihau Rd, Kapa'a, HI 96746
(808) 822-4961

HHSC, Kauai Region is seeking written quotations from qualified Contractors to install lead shielding for a mobile radiographic x-ray room located at the Urgent Care Clinic at Poipu.

Contractor shall schedule a site visit with the Technical Representative, John Pimental at (808) 645-0530, jopimental@hhsc.org. For all contractual inquiries, please contact Cora Shirai at (808) 338-9454, cshirai@hhsc.org.

Written proposals must be submitted to the Contract Manager, Cora Shirai no later than 2:00 pm on August 15, 2019.

A. INTENT

Kauai Region desires to enter into an agreement with a single Contractor to install lead shielding for a mobile radiographic x-ray room. The Contractor shall provide all materials and labor necessary to complete the project.

B. GENERAL REQUIREMENTS (See Attached Exhibit A)

C. SUBMITTALS:

Contractor shall submit for approval 2 complete sets of submittals as described below.

- a. Contractor shall submit preconstruction submittals for review and approval which will consist of but not limited to the following items. Performance & Payment Bond, Certificate of Insurance, Safety Plan, State of Hawaii Contractors License to perform the work described, project schedule, schedule of values, a floor plan of the anticipated location of the new installed equipment, drawings denoting changes to the existing utilities to include but not limited to new power circuits, and changes to existing plumbing and mechanical systems, a list of all subcontractors, work plan, and a list of key personnel with contact information.
- b. Contractor shall provide documentation on Warranty period.

D. QUALITY ASSURANCE

- a. Submit qualifications of the individuals that will be providing the installation. Installation shall be accomplished by factory trained personnel that have a minimum of two to five years' experience in the installation of the system that the Contractor/bidder is proposing.



E. GUARANTEE AND CERTIFICATE

- a. Contractor for a period of one (1) year shall certify in writing and guaranty all work performed in the installation of the lead shielding. The Contractor shall replace any defective item at no cost within this period.
- b. The one year (1) year warranty shall start at the end of thirty (30) consecutive days of trouble free operation.
- c. During the warranty period the contractor shall upon receipt of notice from the Hospital make all repairs. The contractor shall respond to all notices within 4 hours after receipt of notification by phone and 48 hours onsite.

F. DELIVERY, STORAGE AND HANDLING

- a. The Contractor shall be responsible for all receiving, handling, and storage of their materials at the job site.
- b. Use of loading docks, owner's equipment and etc. shall be coordinated with the hospital prior to arrival of materials.
- c. Storage space at the site is very limited. The Contractor shall be responsible for the security of this area and its materials. The Contractor shall be responsible for eliminating the effects of the outside environment in regards to their equipment.

G. RUBBISH

- a. Contractor shall remove rubbish and debris resulting from his work on a daily basis. Rubbish not removed by the Contractor will be removed by the hospital and back-charged to the Contractor.

H. HOURS OF WORK

- a. All work shall be conducted during normal work hours, 7:30 a.m. to 4:00 p.m. Monday through Friday. Noise restrictions do apply. Work performed outside of the hours above shall be approved by the hospital prior to work being performed. If work needs to be performed after normal work hours the Contractor shall be responsible for any cost the hospital incurs to provide necessary personnel to comply with its operations requirements.

I. SCHEDULING OF WORK

- a. Contractor shall provide a work plan and schedule so that it can be coordinated with the Technical Representative



J. COMPLETION OF PROJECT

- a. Kauai Region is requesting that the project be completed by **November 30, 2019** or earlier. If Contractor is not able to complete the project by this date, please provide an estimated date of completion. Award of the contract may depend on the estimated completion date by the Contractor.

K. PRICING

Price proposals shall be sent to Cora Shirai, Contract Manager, no later than 2:00 pm, August 15, 2019. Please call 808-338-9454 if you have any questions regarding this RFQ.

L. CONTRACT

- a. Award of a contract shall be made to the most responsible and responsive offeror whose proposal provides the best value. Price proposals will be evaluated and a contract awarded.
- b. Failure to provide any of the required documents such as the Certificate of Insurance, Performance & Payment Bond, Certificate of Good Standing etc. may result in a non-award.
- c. Only the HHSC contract template will be used.
- d. Requirements for the contract:
 1. Certificate of Good Standing
HAWAII BUSINESS. A business entity referred to as a "Hawaii Business", is registered and incorporated or organized under the laws of the State of Hawaii. As evidence of compliance, the CONTRACTOR shall obtain/possess Certificate of Good Standing issued by the Department of Commerce and Consumer Affairs Business Registration Division (BREG). A "Hawaii Business" that is a sole proprietorship, however, is not required to register with the BREG, and therefore not required to submit the certificate. A CONTRACTOR's status as sole proprietor and its business street address as indicated on the proposal transmittal cover letter (APPENDIX A) will be used to confirm that the CONTRACTOR is a Hawaii Business.
 2. COMPLIANT NON-HAWAII BUSINESS. A business entity referred to as a "Compliant Non-Hawaii Business" is not incorporated or organized under the laws of the State of Hawaii but is registered to do business in the State. As evidence of compliance, the CONTRACTOR shall obtain/possess Certificate of Good Standing issued by the Department of Commerce and Consumer Affairs Business Registration Division (BREG).

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The **Certificate of Good Standing** can be obtained by phone (call (808) 586-2727, Monday thru Thursday 7:45-4:30 HST) or by mail (Department of Commerce and Consumer Affairs, Business Registration Division, P.O. Box 40, Honolulu, Hawaii 96810). The certificate is valid for six (6) months from date of issue and must be valid on the date it is received by HHSC.

3. **Performance & Payment Bond**

Upon the acceptance of the proposal by Kauai Veterans Memorial Hospital, the CONTRACTOR must enter into and execute a contract and furnish a Performance and Payment bond, as required by law.

Introduction

An evaluation of the shielding requirements for a mobile radiographic x-ray room was performed according to the procedures and recommendations of the National Council on Radiation Protection and Measurements Report No. 147, *Structural Shielding Design for Medical X-Ray Imaging Facilities*. Although this facility

For this evaluation, room dimensions, sizes, and layouts were obtained from Marc Ventura, AIA, LLC. Drawings showing the sizes and layouts of the x-ray room and the uses of areas surrounding the room are attached to this report.

General Requirements

1. Steel nails or screws used to secure lead barriers need not be covered with lead discs or supplementary lead. Steel nails or screws generally attenuate radiation equally, or more effectively, than the displaced lead.
2. Where the edges of two lead sheets meet, there should be an overlap of at least 1 cm.
3. Lead shielding should be installed to a height of at least 7 feet from the finished floor.
4. Viewing windows should be made from lead glass or lead acrylic of the same shielding effectiveness as the wall in which they are installed, unless otherwise specified in the Specific Shielding Requirements. Frames for viewing windows should have lead installed in them that overlaps the lead glass or lead acrylic.
5. Doors should have the same shielding effectiveness as the walls in which they are installed, unless otherwise specified in the Specific Shielding Requirements. Door frames should have lead installed in them so there is an overlap over the door edge around the entire door jamb.
6. Shielding should be constructed so there are no voids from penetrations for pipes, conduits, wall outlets, or ducts. Where wall outlets, pipes, ducts, or conduits penetrate the shielding, they shall be covered with additional lead that overlaps the edges of the opening in the shielding. Where possible, penetrations of shielding should occur only in secondary barriers.
7. A Radiation Protection Survey of the finished room shall be performed by a qualified Medical Physicist within six months after installation of the x-ray equipment.

Assumptions and Formulas Used

1. The workload and kVp distribution are taken as that which represents a practical value

for the specified use. Unless site specific data is available, workloads corresponding to a busy facility, as described in NCRP 147, are used.

2. Values for Occupancy Factors and Use Factors were assigned according to the function and occupancy of each surrounding area given in NCRP Report No. 147.
3. In keeping with the ALARA recommendations of the National Council on Radiation Protection and Measurements Report No. 116, Limitation of Exposure to Ionizing Radiation, maximum allowable weekly exposures were set to 0.1 mGy/week for occupational workers and 0.02 mGy/week for non-occupational workers. Maximum weekly exposures for unexposed film storage locations were set to 0.025 mGy/week. For locations where loaded cassettes will be stored, maximum weekly exposures were set to 0.0025 mGy/week.
4. The following formulas were used for calculation of required additional shielding, as described in NCRP Report No. 147:

For the Chest bucky wall, the required thicknesses for the primary barrier directly behind the bucky is calculated. The shielding thickness required to shield the area next to the bucky from scattered radiation is also calculated. The larger of these two thicknesses is used for the entire wall. Formulas for primary and secondary barrier are shown below:

$$x_{Pri} = \frac{1}{\alpha\gamma} \ln \left(\frac{\left(\frac{Z_{Pri}TU}{P}\right)^{\gamma} + \frac{\beta}{\alpha}}{1 + \frac{\beta}{\alpha}} \right) - x_{pre}$$

$$Z_{Pri} = \frac{N_{Rad} K_{P(Chest)}}{d_{P(Chest)}^2}$$

$$x_{Sec} = \frac{1}{\alpha\gamma} \ln \left(\frac{\left(\frac{Z_{Sec}T}{P}\right)^{\gamma} + \frac{\beta}{\alpha}}{1 + \frac{\beta}{\alpha}} \right)$$

$$Z_{Sec} = \frac{N_{Rad} K_{SL(Table)}}{d_{S(Table)}^2} + \frac{N_{Rad} K_{S(Chest)}}{d_{S(C.Bucky)}^2} + \frac{N_{Rad} K_{L(Chest)}}{d_{L(C.Tube)}^2}$$

Where:

P is the permissible weekly exposure in mGy per week;

- N is the number of patients per week (for either Radiographic or Fluoroscopic exams);
- T is the Occupancy Factor;
- U is the Use Factor (*Note: no use factor is necessary for chest bucky barriers, since this factor is built into the K value for this type of barrier*);
- d_P is the distance from the tube to the point in question (one foot beyond indicated wall);
- d_S is the distance from the scatter source to the point in question (one foot beyond indicated wall);
- d_L is the distance from the tube (source of leakage radiation) to the point in question;
- x is the shield thickness;
- x_{pre} is the amount of pre-shielding provided by the imaging hardware, taken from Table 4.6 of NCRP 147;
- K_P is the primary radiation exposure at a distance of one meter from the x-ray tube, in units of mGy per patient, which is dependent on the room type and barrier type, taken from Table 4.5 of NCRP 147;
- K_{SL} is the secondary radiation exposure (including scatter and leakage) at a distance of one meter from the patient, in units of mGy per patient, which is dependent on the room type, taken from table 4.7 of NCRP 147; and
- α, β, γ are parameters dependent on shielding material and kVp distribution, and are taken from Appendices B and C of NCRP 147.

For the cross-table wall, contributions from primary and secondary radiation are considered. Due to the variables involved, the required shielding thickness for a particular target dose rate cannot be calculated directly. Instead, a particular shielding thickness is assumed, and the projected dose rate is calculated and compared to the target dose rate. The shielding thickness is adjusted until the projected dose rate is below the target dose rate. There are two different sources for secondary radiation which are considered for the cross table wall: (1) Scatter and leakage from radiographic patients examined on the table, and (2) Scatter and leakage from radiographic patients examined with the chest bucky. Dose contributions are calculated separately from each source and added together to determine D_{Sec} . Formulas are shown below:

$$D_{Proj} = D_{Pri} + D_{Sec}$$

$$D_{Pri} = \frac{N_{Rad} T K_{P(Rad)} U}{d_{P(cross)}^2} \left[\left(1 + \frac{\beta}{\alpha} \right) \left(e^{(x+x_{pre})\alpha\gamma} - \frac{\beta}{\alpha} \right) \right]^{-\frac{1}{\gamma}}$$

$$D_{Sec} = \frac{N_{Rad} T K_{SL(Rad)} U}{d_{SL}^2} \left[\left(1 + \frac{\beta}{\alpha} \right) \left(e^{x\alpha\gamma} - \frac{\beta}{\alpha} \right) \right]^{-\frac{1}{\gamma}}$$

For the floor beneath the table, primary radiation from the overhead tube is the only consideration. For the floor areas away from the table, scatter and leakage from radiographic patients is the only consideration. The required thicknesses due to primary and secondary radiation are calculated separately, and the larger of the two values is reported. Formulas are similar to those shown for the chest bucky wall.

For the ceiling, scatter and leakage from radiographic patients is the only consideration. Formulas are similar to those used for chest bucky wall secondary barrier calculation.

For walls not described above, there are two different sources for secondary radiation which are considered: (1) Scatter and leakage from radiographic patients examined on the table, and (2) Scatter and leakage from radiographic patients examined using the chest bucky. Formulas are similar to those used above.

Specific Shielding Requirements

1. Wall A shall have a minimum of 4 lb/ft² lead shielding added. The door installed in wall A shall be provided with a minimum of 4 lb/ft² lead shielding.
2. Wall B shall have a minimum of 2 lb/ft² lead shielding added.
3. Wall C shall have a minimum of 2 lb/ft² lead shielding added.
4. Wall D shall have a minimum of 2 lb/ft² lead shielding added.
5. A mobile lead barrier will be available in the room for the protection of the technologist (location E). This barrier shall have a minimum shielding equivalence of 0.5 mm lead. The technologist must stand behind this barrier during all exposures. The barrier must be positioned to provide protection from both tube leakage radiation and radiation scattered from the patient.
6. The floor shall have a minimum of 2 lb/ft² lead shielding added.