

REGULATORY GUIDE B6

X-RAY FACILITY SHIELDING PLANS



SC DEPARTMENT *of*
**ENVIRONMENTAL
SERVICES**

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REGULATORY GUIDE B6 X-RAY FACILITY SHIELDING PLANS

Each facility possessing x-ray units requiring shielding plans must submit the appropriate information and comply with Regulations 61-64, X-Rays (Title B). This guide is intended to help facilities in complying with Title B regulations.

SUBMISSION OF SHIELDING PLANS

(See RHB 4.4)

A radiation shielding plan is required for applicable x-ray installations. Shielding plans must be prepared and submitted by a registered vendor (Class III, IV, VII, VIII, or IX, depending on application type). Shielding plans will not be accepted from unregistered vendors. A list of registered vendors is available on the SCDES website.

To request review, complete and submit SCDES Form 0846 "Shielding Plan Review Application," the shielding plan, and supporting documents along with the non-refundable \$62.50 fee. Submit by email to XRayFRA-ShieldingPlans@des.sc.gov or by mail to 2600 Bull Street, Columbia, SC 29201. Fees may be paid by check, or an invoice will be issued after the application is received. Applications are processed in the order received, with a typical turnaround time of 15 business days (excluding weekends and holidays) once a complete submission and payment are received.

As the Department transitions to electronic correspondence, all approval letters and documentation will be delivered electronically. Please maintain digital records, as paper copies will not be mailed.

SHIELDING PLAN REQUIRED

(See RHB 4.4.1)

All new installations of x-ray equipment must have an accepted shielding plan. In addition, any modification to an installation which would render the original shielding plan inaccurate must also have an accepted shielding plan.

Shielding plans are required for:

- 1) All diagnostic medical x-ray units installed at new facilities
- 2) Relocation of a unit within a facility or the relocation of a facility to a new physical address.
- 3) All installations of therapeutic x-ray or accelerator units.
- 4) All installations of x-ray equipment at veterinary offices (excluding intraoral dental units).
- 5) All industrial x-ray units used in shielded room configurations.
- 6) All dental cephalometric, TMJ and Dental CT units.
- 7) Table bone density units (or area survey if prior approval is granted).
- 8) Mobile and portable radiographic units with a permanent cassette holder as addressed in RHB 4.4.4.6.
- 9) Any space utilized as a radiation area for a period of five (5) or more consecutive days.

Shielding plans may be required for:

- 1) Modifications to an existing accepted installation, such as moving the operator's barrier, or installing vertical cassette holder.
- 2) Changes to an accepted plan that may affect the shielding requirements, such as changing the film/screen system used, etc.

The only units that generally do not require shielding plans to be submitted are dental intraoral units, most industrial and analytical x-ray equipment, and peripheral bone density units. In those cases where a plan may or may not be required, please contact the Department for assistance. **DO NOT** assume that a new plan is not needed.

EQUIPMENT REPLACEMENT

(See RHB 4.4.2)

A shielding plan may or may not be required when an x-ray control or generator is replaced.

- 1) A shielding plan is not required upon the replacement of an x-ray control or generator with like equipment and when there are no other changes that would render the original shielding plan inaccurate. This must be determined by a Class III, IV, VII, VIII, or IX vendor. The vendor must notify the Department on SCDES Form 2779 "Control/Generator Replacement Notification (CGRN)". Submit by email to XRayFRA-ShieldingPlans@des.sc.gov or by mail to 2600 Bull Street, Columbia, SC 29201. No fee is required for the submission of the CGRN form. This notification must be submitted to the Department within thirty (30) calendar days of such replacement.
- 2) A shielding plan **is required** when a facility replaces an existing x-ray system.
- 3) A shielding plan is required when an x-ray control or generator is replaced with components with increased capabilities that would render the original shielding plan inaccurate. This must be determined by a Class III, IV, VII, VIII, or IX vendor.
- 4) A shielding plan is required when the parameters of the original shielding plan change to an extent that the original shielding plan is no longer accurate. This must be determined by a Class III, IV, VII, VIII, or IX vendor.
- 5) A shielding plan is required when the original shielding plan is not available.

DEPARTMENTAL REVIEW OF SHIELDING PLANS

(See RHB 4.4.4.2)

The Department will review shielding plans for adequacy according to the appropriate National Council of Radiation Protection and Measurements or an equivalent reference.

After review and acceptance of a shielding plan, the Department may require additional modifications if an analysis indicates the possibility of an individual receiving a dose in excess of the applicable limits.

After a plan is reviewed and accepted, the Department issues a shielding acceptance letter. This letter should be retained by both the vendor and the facility for future reference.

SHIELDING PLAN DESIGN REQUIREMENTS

The following design requirements must be met:

- 1) All wall, floor, and ceiling areas exposed to the useful beam shall have primary barriers. Primary barriers in walls shall extend to a minimum height of at least 2.13 meters or 7 feet above the floor. (RHB 4.4.4.3)
- 2) Secondary barriers shall be provided in all wall, floor, and ceiling areas not having primary barriers. (RHB 4.4.4.4)
- 3) The operator's station at the control must be behind protective barrier either in a separate room or in a protected booth. (RHB 4.4.4.5)
- 4) Mobile and Portable X-ray systems used in conjunction with a permanently installed cassette holder shall be considered a stationary radiographic system and shall meet the requirements for such an installation. (RHB 4.4.4.6).

Mobile and Portable X-ray systems which are used in a single location for a period of five (5) or more consecutive days shall be considered a stationary radiographic system and shall meet the requirements of RHB 4.4, as discussed in RHB 4.8.8. A shielding plan is also required when any space is utilized as a radiation area for a period of five (5) or more consecutive days, as discussed in RHB 4.4.1.2.

All installations are required to meet the above design requirements. If the design requirements cannot be met, the registrant may offer an alternative design to the Department for acceptance. The alternative design must afford the same degree of safety as the specified design requirements. If a particular installation cannot reasonably meet the design requirements, the shielding plan should be submitted to the Department along with a letter stating why the design requirements cannot be met. The Department will give consideration for alternate designs provided that the intent of the regulations is being met.

INFORMATION ON RADIATION SHIELDING REQUIRED FOR PLAN REVIEW

(See RHB 4.4 and Appendix B)

The following information must be provided to the Department for review and acceptance of a shielding plan:

1. Plans shall show, at a minimum, the following:
 - a) The general direction of the useful beam, location of any windows and doors, the location of the operator's booth/station, the location of the x-ray control panel, and the location of the wall bucky or chest board, if applicable.
 - b) The structural composition and thickness or lead equivalency of all walls, doors, partitions, floor, and ceiling of the room concerned.
 - c) An accurate drawing of the room(s) concerned.
 - d) The type of occupancy of all adjacent areas subject to primary and secondary scatter inclusive of space above and below the room concerned. If there is an exterior wall, the distance to the closest area where it is likely that individuals may be present must be given.
 - e) The type x-ray equipment and the maximum technique factors.
 - f) Location of the darkroom and the area where the film will be stored. Any shielding which will be used to protect the film must be noted. The use of filmless systems should be indicated in writing.

2. Information on the anticipated workload of the x-ray system. Give the number of individual exposures per week. This is the total number of exposures, not patients, taken each week. This figure should include allowances for future growth so that shielding will continue to remain adequate.
3. Individual barrier radiation shielding specifications and descriptions of all assumptions that were used in the shielding calculations.
4. The date the plan was prepared and the printed name and signature of the person preparing the plan.

DESIGN REQUIREMENTS FOR AN OPERATOR'S BOOTH/STATION

(See Appendix C)

1. SPACE REQUIREMENTS

- a) The operator must have 7.5 square feet (0.697 m²) of unobstructed floor space in the booth/station.
- b) The operator's booth/station may be any geometric configuration with no dimension less than 2 feet (0.61 m).
- c) The space shall be allotted excluding any encumbrance by the x-ray control panel, such as overhang, cables, or other similar encroachments.
- d) The booth/station shall be located or constructed such that attenuated direct scatter radiation originating on the examination table or at the wall cassette cannot reach the operator's station in the booth/station.

2. STRUCTURAL REQUIREMENTS

- a) The booth walls shall be permanently fixed barriers of at least 7 feet (2.13 m) high.
- b) When a door or movable panel is used as an integral part of the booth structure, it must have an interlock which will prevent an exposure when the door or panel is not closed.
- c) Shielding shall be provided to meet the requirements of RHB 4.4.

3. X-RAY CONTROL PLACEMENT

- a) The x-ray control shall be fixed within the booth/station and shall be at least 40 inches (1.02 m) from any open edge of the booth wall which is nearest to the examination table, excluding mammography and dental systems
- b) If the exposure switch is separate from the control panel, the exposure switch shall be at least 40 inches from any open edge of the booth wall which is nearest the source of radiation, excluding computed tomography exposure switches designed to provide a delay before initiating x-rays.
- c) The x-ray control shall allow the operator to use the majority of the available viewing windows and allow the operator to control all access to the radiation area.

4. VIEWING SYSTEM REQUIREMENTS

- a) Each booth shall have at least one viewing device which will be placed so that the operator can view the patient during each exposure and allow the operator to have full view of any occupant of the room. The device should also be placed so that the operator can view any entry into the room. If any door which allows access to the room cannot be seen from the booth/station, then that door must have an interlock controlling the exposure which will prevent the exposure if the door is not closed.
- b) When the viewing system is a window, it must have at least 1 square foot (0.0929 m²) of viewing area. The design of the booth shall be such that the operator's position when viewing the patient and operating the x-ray system is at least 18 inches (0.457 m) from the edge of the booth. The view window must have the same lead equivalence as that required in the booth's wall in which it is mounted.
- c) When the viewing system is by mirrors, the mirror(s) shall be so located as to accomplish the same general requirements as discussed in (a) above.
- d) When the viewing system is by electronic means, the camera shall be so located as to accomplish the general requirements of (a) above, and there shall be an alternate viewing system as a backup for the primary system.

MAMMOGRAPHY SHIELDING REQUIREMENTS

(See RHB 4.4.8)

A shielding plan or radiation area survey, which is acceptable only if prior approval is given, is required for mammography units. Shielding plans must be submitted and accepted by this Department prior to installation, or a written request must be made by a Class III, VII, or IX vendor to perform a post-install survey in lieu of a shielding plan.

Both shielding plans and requests for post installation radiation area surveys require the submission of a shielding review fee of \$62.50 and shielding plan review application.

POST INSTALLATION REQUIREMENTS

(See RHB 4.4.6.1 and 4.4.7.1)

X-RAY EQUIPMENT SHALL NOT BE INSTALLED OR OPERATED BEFORE A SHIELDING PLAN FOR THE UNIT HAS BEEN ACCEPTED BY THE DEPARTMENT.

X-ray equipment shall be installed according to the accepted shielding plan. Deviations shall be documented in accordance with RHB 4.4.6.3 and 4.4.7.2.

1. AS-BUILT DRAWINGS (RHB 4.4.7.1)

Within thirty (30) calendar days of installation, the facility shall ensure that "as-built" drawings are submitted to the Department along with SCDES Form 4112 "As-Built/Area Survey Submission Form". Submit by email to XRayFRA-ShieldingPlans@des.sc.gov or by mail to 2600 Bull Street, Columbia, SC 29201. The drawings must indicate the composition of the walls, floor, ceiling, windows and doors. The drawings must also indicate the placement of the x-ray equipment, including the table, control, and

vertical cassette holder, if provided, as well as the location and composition of the film bin, if present. Any deviation from the accepted shielding plan shall be documented and evaluated for adequacy by a Class III, Class IV, Class VII, Class VIII, or Class IX vendor.

2. AREA SURVEYS (RHB 4.4.6)

Within thirty (30) calendar days of installation, a radiation area survey must be completed and submitted along with SCDES Form 4112 "As-Built/Area Survey Submission Form". Submit by email to XRayFRA-ShieldingPlans@des.sc.gov or by mail to 2600 Bull Street, Columbia, SC 29201. This survey must be performed by a Class III, Class VII, or Class IX vendor, registered with the Department. Any deviation from the accepted shielding plan shall be documented and evaluated for adequacy.

A complete survey shall include the following:

- a) An accurate drawing of the room indicating the placement of the x-ray equipment, including the table, control, and vertical cassette holder, if provided.
- b) Indication of the composition of the walls, floor ceiling, windows, and doors.
- c) The location and composition of the film bin, if applicable.
- d) An evaluation of the adequacy of each protective barrier to include the ceiling and the floor, the operator's location, and the film storage area, if appropriate.
- e) The date performed and legible signature of the person who performed the survey.
- f) A certification that the shielding is adequate.

QUESTIONS

If you have questions, please feel free to call, email, or write:

SC Department of Environmental Services
Radiation Protection Program
2600 Bull Street
Columbia, SC 29201
PHONE: (803) 545-4400
FAX: (803) 545-4412

EMAIL –

REGISTRATIONS: XRayRegistration@des.sc.gov

FACILITY REGISTRATION APPROVALS AND SHIELDING PLANS: XRayFRA-ShieldingPlans@des.sc.gov

REGULATORY GUIDES

B1 - Registration of X-ray Facilities and Equipment
B2 - Complying with Title B - Medical Facilities
B3 - Complying with Title B - Dental Facilities

B4 - Complying with Title B - Facilities Utilizing Analytical or Industrial X-ray Equipment
B5 – Complying with Title B - Vendors
B6 – X-Ray Facility Shielding Plans
B7 - Complying with Title B - Mammography
B8 - Complying with Title B - Personnel Security Screening Systems
B9 - Complying with Title B - Veterinary Facilities
B10- Complying with Title B - Hospitals

Visit our website at: <https://des.sc.gov/programs/bureau-land-waste-management/radiation-protection-program/x-ray-regulations>