

**Radiology Physics Department
Cork University Hospital**

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**Shielding Specification of General X-Ray Room 4D, Radiology Department, Cork
University Hospital.**

1. Introduction

This is a shielding specification for the upgrade of General X-Ray Room 4D which will involve the replacement of the Arcoma Intuition General X-Ray system with a Carestream DRX Evolution X-Ray system, the addition of a sliding door access behind the console screen and a change in the position of the double doors. The layout of the proposed room upgrade has been provided by Medray (Appendix A).

Please note **if there any further changes** to the proposed Room layouts or the spaces adjacent that Room, the shielding specification will **need to be reviewed** to account for them.

2. Location of General X-Ray Room 4D

CRC Room 4D is located on the fourth floor of the Cardiac Tower (Appendix B). The room currently houses an Arcoma Intuition digital radiographic X-Ray system which has both table and chest Bucky functionality. Room 4D is bounded by a corridor wall (20% Occupancy), a ward area wall (100% Occupancy), a staff WC wall (10% occupancy) and an external fourth floor wall (No Occupancy). It is above a mixture of room spaces on the third floor (offices, toilets, housekeeping, etc), and similarly, it is below a mixture of room spaces on the fifth floor (office spaces and toilets).

3. Existing Shielding of General Room 4D

As detailed in the 2011 risk assessment of Room 4D the room measures $\sim 6.3 \times 4.5$ m with a floor to full ceiling height of 3 m¹. All four walls have been lead-lined with Code 6 to allow for some flexibility for change in use and/or workload into the future. Both the floor and ceiling are composed of 300 mm solid concrete slab. According to the risk assessment there is a service breach in the concrete slab ceiling (to accommodate the sewer pipe for the toilet upstairs) and this has been shielded with code 6 lead. The console door is specified as code 5 and the control panel (Figure 1) has both screen and lead glass marked as 2.6mm Pb equivalent @ 150kV.

4. Proposed Room Modifications

There are two modifications to the room evident from the layout shown in Appendix A: the position of the double doors is moved approximately 800 mm closer to the console area and a new sliding door access behind the console screen. Those aside, the new room layout appears to be similar to the existing one.

5. Shielding Assessment of the upgraded General Room 4D

Shielding assessments should be carried out by an RPA and based on actual X-Ray Room workloads, room dimensions and the occupancy of adjoining areas. Shielding calculations for the new room were based upon methods described in “The Design of Diagnostic Medical Facilities where Ionising Radiation is used”, Radiological Protection Institute of Ireland (RPII), 2009 and ‘Radiation Shielding for Diagnostic Radiology’ by DG Sutton et al, Report of a BIR working party, published 2012 by BIR^{2,3}. A target dose of 0.3mSv/year was applied to all areas adjacent to the rooms.

Shielding calculations were based on an estimated annual workload figure of 7,436 examinations (max in last 10 years) extended over a 10 year room lifetime with a 5% increase in workload per year. The DAP values used in calculations were taken from DoseWatch. A tube voltage of 90kV average was assumed for Table Bucky exposures and 125kV average was assumed for Erect Bucky exposures. In addition a safety margin of 100% was applied to the weekly workload for the shielding calculations to allow for variances in data, changes in imaging workloads, etc.

6. Shielding Specification of the upgraded Room 4D

The EPA have advised that the boundaries of a general X-Ray room with all occupied areas should be appropriately shielded, and as a general guide, suggest that this requirement will be met with Code 5 lead shielding². Calculations performed as part of this assessment indicate that the existing Code 6 Pb shielding should be sufficient for the boundaries of the upgraded Room 4D.

6.1 Walls bounding the Room 4D

Calculations performed as part of this assessment indicate that the existing floor-to-ceiling Code 6 Pb shielding should be more than sufficient for the walls bounding Rooms 4D.

6.2 Doors in Room 4D (comprising the double doors and the single sliding door in to the corridor)

The existing double doors and door frame in Room 4D shielded with Code 5 Pb should be sufficient for the upgraded room. If the double doors are relocated in the corridor wall the vacated wall space will need to be shielded consistent with the whole corridor wall ie

Code 6 Pb. The new sliding door and door frame should be shielded with Code 3 Pb, or greater.

6.3 X-Ray Console Screen

The existing console screen which is shielded to 2.6 mm Pb equivalent at 150 kV (labelled) should be sufficient for the upgraded room. It is advised to have a console screen door to shield staff behind the screen from secondary scatter from the erect Bucky and to shield staff using the sliding door access. The existing console screen incorporates a shielded door which is a requirement for the upgraded room.

6.4 Floor/Ceiling of Room 4D

There are a mixture of rooms, including office spaces, above/ below Room 4D and the calculations indicate that the shielding provided by the 300 mm thick concrete slab ceiling/floor should be more than sufficient for those areas.

6.5 Requirements of the Environmental Protection Agency (EPA) (ie dealing with overlaps, backings and labeling)

The requirements of RPII 2009 (Pages 77 to 86 and Appendix F, pages 100 to 102) must be observed with respect to overlaps and backings at all walls, doors, screen and window joints and any perforations of the walls. *This document may be downloaded from the Publications section at www.epa.ie*

The EPA also requires that all new and existing shielding is labelled with the lead equivalence. This applies to doors, walls, lead glass windows, mobile screens or other radiation protection devices.

6.6 Personnel shielding

Lead aprons of at least 0.25 mm lead equivalence are recommended (for comforters and carers). Similarly thyroid collars should be provided. Suitable storage for personal protective equipment should be provided and easily accessed.

6.7 Warning Lights and Signs

Modern dual colour warning lights are required outside any door which facilitates access to the X-Ray Room Controlled Area including the double doors from Corridor and the single door from the patient changing room. The warning lights should be linked to the operation of the X-Ray unit (both X-Ray units in Room 1). If possible the lights should be placed at eye level beside the doors.

Warning notices should be fixed to the outside of each door accessing the X-Ray Rooms.

7. Inspection of Shielding installation by RPA or MPEs

It is **very important** that the RPA gets appropriate notice of the installation of any Room shielding and an MPE/ RPA are **allowed access** to the building site by arrangement in order to **assess and inspect the lead shielding** during the process of installation.

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References

1. Radiology Physics. XRD_201611_Room_3 \\\pcuhdfs\pr03.healthirl.net\DFS-03-D\Medical Physics\05 Radiology Physics\06 Radiation Protection\Risk Assessments\X-Ray\CUH\XRD\General Room 4D\2016\
2. Radiological Protection Institute of Ireland. The Design of Diagnostic Medical Facilities where Ionising Radiation is used. June, 2009.
3. Sutton, DG, Martin, CJ, Williams, JR, Peet, DJ. Radiation Shielding for Diagnostic Radiology, Report of a BIR Working Party, 2012

Appendix B: Location of Room 4D on the fourth floor of the Cardiac Tower

