The Australian MRI-Linac Program: Measuring Profiles and PDD in a horizontal beam

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Introduction: The Australian MRI-Linac Program (AMP) [1] is developing a 1-T open-bore MRI/6-MV linac using a Varian Linatron-MP (Palo Alto, USA) horizontal 6-MV beam. Measurement of standard dosimetry data, profiles across a field and percentage depth doses (PDDs), requires a revision to standard methodology, for a horizontal beam line as is necessary for AMP and other advanced technologies. This work presents the methodology used to measure large field profiles and PDDs for a horizontal beam in a Scanditronix Wellhofer Blue Phantom (IBA-Dosimetry, Germany).

Materials and Methods: The MRI-bore axis was marked out on the floors and walls of the MRI-Linac bunker, providing a reference axis for the water tank. For horizontal beam measurements orthogonality of the watertank front surface to the radiation beam axis was verified using lasers to align both the water tank and a CC13 ionisation chamber to the MRI-bore axis. The CC13 ionisation chamber was used to measure PDD and profiles from the horizontally aligned Linatron at 2770mm SSD. Isocentre depth position was set as close to the target as the watertank side would physically allow. Corrections for the distance between the centre of the chamber at this position and the outside surface of the watertank, $P_{eff}$ and effective wall thickness of the watertank $(t_{wall} + \rho_{pl})$[2] were applied post-measurement. Gafchromic EBT3 film was used to measure PDD and profiles in the buildup region where the chamber could not physically measure.

Results: Wall material of the Blue Phantom is 15mm thick Acrylic plastic (Perspex) with a water equivalent thickness of 17.8mm. A central axis offset from the inside wall of the tank was 17mm. A combination of film and watertank PDD measurements of an open field corrected for the depth offsets described above is shown in figure 1. A PDD of 69.1 % was measured at 10 cm depth.

Conclusions: The methodology described can be used to undertake dosimetry measurements with horizontal beams consistently as necessary for the Austral- ian MRI-linac program.

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References:

Figure 1: PDD measured on the Linatron using a combination of water tank and film data.