Comparison of Radiation Shielding Requirements for ^{192}Ir, ^{60}Co and ^{169}Yb HDR Brachytherapy Sources Using Monte Carlo Simulations

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A- Summary

With the aim of comparing the differences in the shielding requirements, the results of this study show that:

- Selection of ^{169}Yb over ^{192}Ir and ^{60}Co sources would afford significantly less massive direct shielded doors
- For facilities with a typical maze, the ^{169}Yb source may not afford a significant saving on the shielding thickness requirement for the door
- Radiation leakage may dominate the dose rate behind the door even when the core lead thickness has been correctly specified

B- Monte Carlo simulations

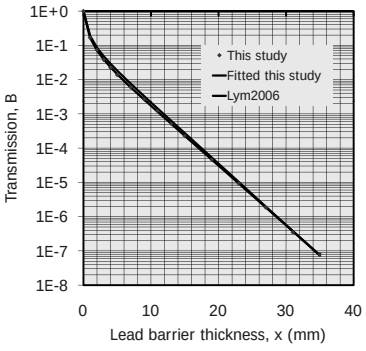
- Realistic modelling of brachytherapy radiation sources , placed at the centre of a typical treatment room in air and also at the centre of a water phantom
- MCNPX version 2.5.0
  - Photon Flux Mesh Tally
  - Particle Flux Tally – dose function modified
  - Cut-off energy 10keV
  - Relative errors < 5% (1.s.d.)

C- Results 1: Primary barrier

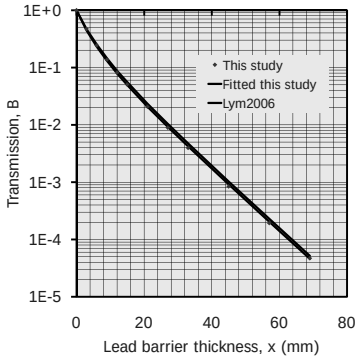
- For the ^{169}Yb source the lead thickness reduction relative to the ^{192}Ir source was found to be about three HVLs

- The primary barrier lead thickness required for the ^{60}Co source was found to be about five HVLs higher than that required for the ^{192}Ir source

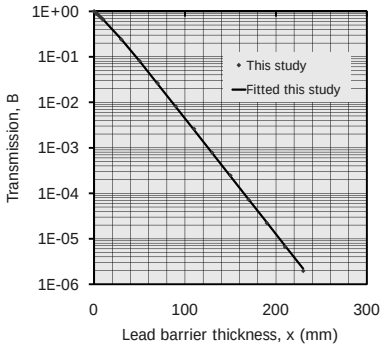
(i) Monte Carlo calculated broad beam transmission, B, for ^{169}Yb sources in lead



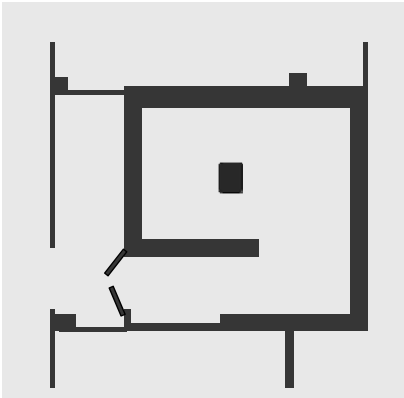
(ii) Monte Carlo calculated broad beam transmission, B, for ^{192}Ir sources in lead



(iii) Monte Carlo calculated broad beam transmission, B, for ^{60}Co sources in lead



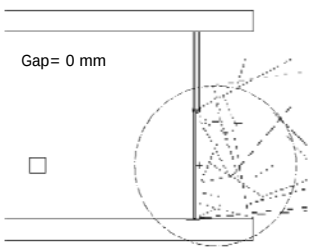
D- Results 2: Door shielding

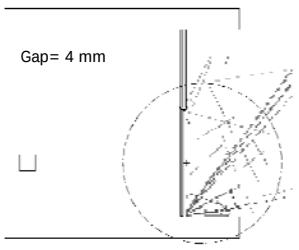


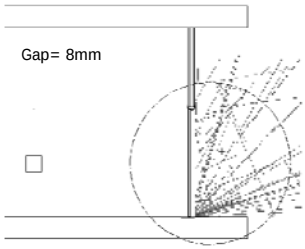
	Dose rate behind the shielded door (μSvhr^{-1})*		
	^{169}Yb	^{192}Ir	^{60}Co
6 mm Pb door No phantom	0.6	0.7	3.0
6 mm Pb door With water phantom	0.2	0.4	1.6
9 mm Pb door No phantom	-	-	1.8
9 mm Pb door With water phantom	-	-	1.0

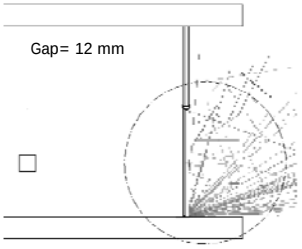
** For typical ^{192}Ir and equivalent ^{169}Yb and ^{60}Co sources set-up at the centre of a treatment room with a maze*

E- Results 3: Leakage through the door & floor gap









The lead mat solution: