HDR Ir^{192} Shielding Calculation

$$RF = \frac{WUT}{Pd^2}$$

Where W = Workload
U = Use factor
T = Occupancy factor
P = design goal
d = distance
RF = Reduction factor

For primary barriers U = 1, Incase of HDR Ir^{192} Brachytherapy, all the barriers are primary barriers, since all the barriers recieve radiation at same time

Lets us consider (i) full occupancy T = 1

(ii) P = 2 mR/week [for uncontrolled area]
(iii) d = 3m

Workload = 20 patients per week with typical treatment time of 5 minutes

Total treatment time per week = $20 \times (5/60)$ hours
= 1.66 hours.

To be more conservative, Let's consider Total treatment time to be 3 hours

Γ_x = Exposure rate constant

Γ_x for Ir^{192} = 4.69×10^{-4} R m^2/mCi h

Activity = 10 Ci

Weekly Workload = 3 hours x 10×10^{3} mCi x 4.69×10^{-4}

= 14 R/week at 1m

Lets consider a conservative value of

20 R/week at 1m.

$$RF = \frac{20 \text{ R/week} \times 1 \times 1}{(2 \times 10^{-3}) \times (3)^2}$$

$RF = 1.11 \times 10^{3}$

$\log_{10}(RF) = 3.045$

TVL of concrete of I_r^{192} = 13.5 cm

Thickness required = 3.045 x 13.5

= 41.1 cm.

For same number of patient, typical treatment time, d = 3m, U = 1, T = 1, P = 2m R/week

The Barrier thickness required for 2Ci Co^{60} HDR source is

W = 3 hours x 2 Ci x 1.32 R/Ci-h at 1m.

= 7.92 R/week at 1 m.

Conservative Value of 10 R/week at 1m is considered for calculation.

$RF = 10 / [2 \times 10^{-3}] \times [3]^2$

$RF = 5.55 \times 10^{2}$

$\log_{10}[RF] = 2.744$

For Co^{60}, TVT = 20.6 for concrete

Thickness required = 2.744×20.6

$= 56.53$ cm

For Ir^{192} 10 Ci source 41.1 cm thickness is required

For Co^{60} 2 Ci source 56.53 cm thickness of concrete is required for shielding

Hence 2 Ci Co^{60} HDR source cannot be placed in a 10 Ci Ir^{192} HDR source concrete bunker