MAXIMUM DOSE RATE IN BOOSTER TUNNEL DIRECTLY UNDERNEATH LINAC BEAM TRANSPORT PIPE

M. Awschalom

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Parameters[1]

1. $(di/dL)_{Transport} = 0.1\ (di/dL)_{Linac}$

   $= 3.76 \times 10^7$ protons cm^{-1} sec^{-1}

   $B = 121.4$ Rem cm/hr

2. thickness of heavy concrete (QCM aggregate)

   = 3.5 ft (local shield + heavy concrete "horse-shoe")

   $x = 3.5 \times 30.45 \times 3.95\ g/cm^3 = 420\ g/cm^2$

3. removal mean free path correction due to exchange of heavy concrete for ordinary concrete,

   $\lambda = (117/112)\ 85.802 = 89.63\ g/cm^2$

4. approximate distance to worker's eyes,

   R = 7.5 ft = 228 cm

Then,

$$D(228\ cm,\ 420\ g/cm^2) = \frac{121.4}{228} \exp(-420/89.63) = 4.9\ m\ rem/hr$$

This dose rate may be off by a factor of 2 to 3, hence

Maximum Dose Rate $\leq$ 15 m rem/hr

This dose rate falls off very quickly as shown in the accompanying graph as curve A.

If one would consider making the "horse-shoe" with ordinary concrete, then D_{max} (1 ft ord. + 2.5 ft heavy) = 18 m rem/hr and with the uncertainty factor of 3, $D_{max} \leq 54$ m rem/hr. This dose rate and its fall off appears as curve B.

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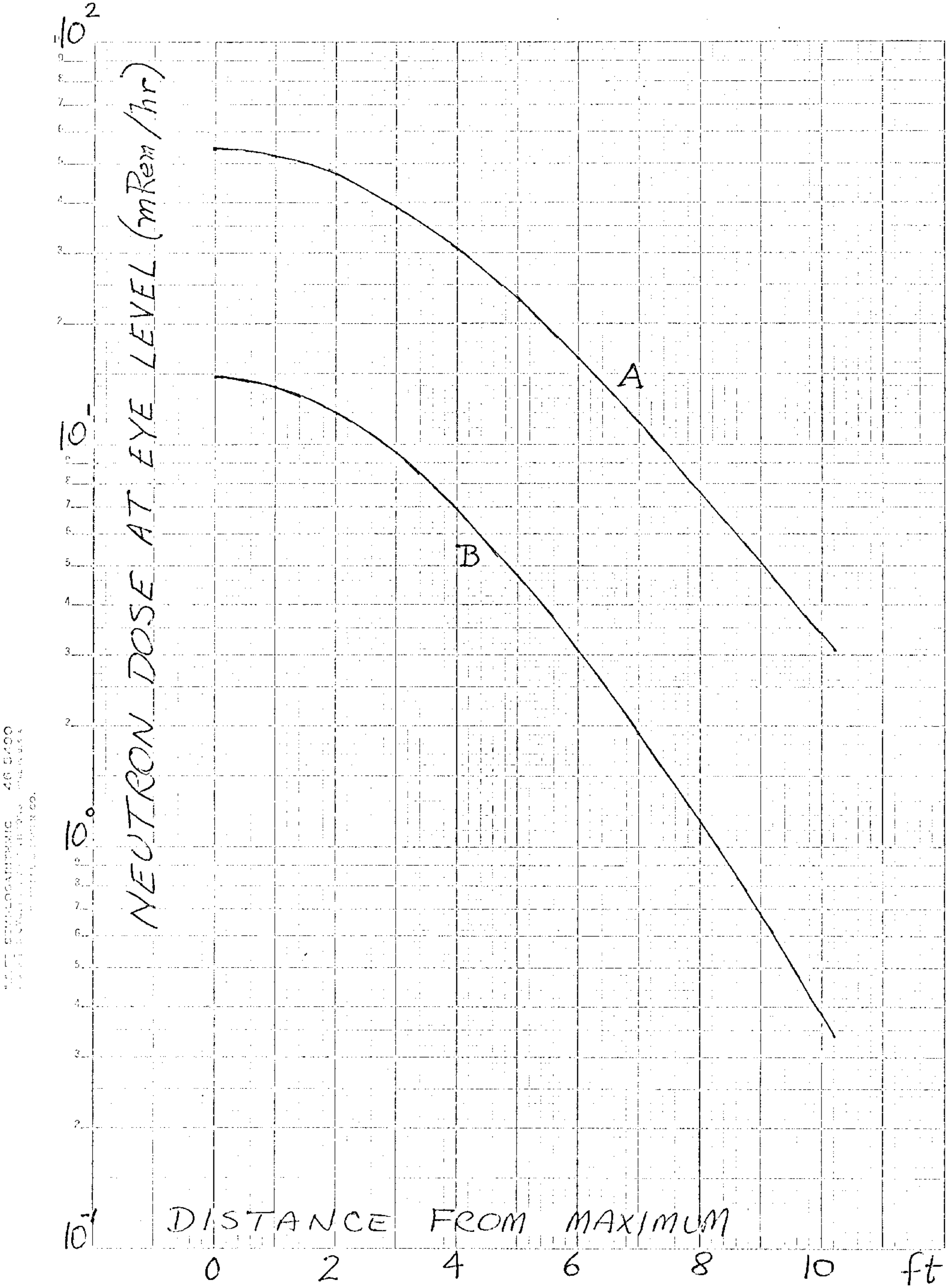
[1] The neutron dose to a person standing just outside a thick shield (450 to 1200 g/cm^2) can be expressed as $D(R, x) = B \cdot R^{-1} \exp(-x/\lambda)$.
B = 1214 Rem · cm hr^{-1}, for a (di/dL) of 3.76×10^8 (200 MeV protons/sec)/cm
R = distance from subject to point of beam loss, cm
x = absorber thickness, g/cm^2
λ = removal mean free path, g/cm^2
= 85.802 g/cm^2 for neutrons in ordinary concrete from 200 MeV protons on Cu. It must be changed by (117/112) for NAL type of heavy concrete.

FIGURE CAPTION

Booster Enclosure. Neutron dose rate at eye level versus distance from point of closest approach to linac slanting beam transport pipe. $(dI/dL) = 3.76 \times 10^7$ protons cm^{-1}sec^{-1}.

Curve A: Shield = 1 ft ordinary concrete + 2.5 ft heavy concrete

Curve B: Shield = 3.5 ft heavy concrete



NEUTRON DOSE AT EYE LEVEL (mRem/hr)
DISTANCE FROM MAXIMUM
A
B
0
2
4
6
8
10
ft