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Sameer S. A. Natto

natto@uqu.edu.sa :

### Dose in the Buildup Region for a High-energy Medical Linear Accelerator X-Ray Photon Beam (Measurements and Calculations)

#### Abstract

Discrepancies between measurements and Monte Carlo calculations in the buildup region of a high-energy x-ray photon beam from the Varian Clinac-23EX medical linear accelerator were studied in this work. The study involved irradiation fields at 10 × 10, 20 × 20 and 40 × 40 cm<sup>2</sup>. A 6 MV photon beam from the Clinac 23EX is measured at different depths in a water phantom using WELLHOFER WP700 beam scanner using an ionization chamber with a cavity radius of 3 mm. The Monte Carlo Code MCNP4B2 is used to simulate the incident beam and in dose calculations in the water phantom. Discrepancies between measurements and Monte Carlo calculations were found to be not more than 7% at any field. Possible causes of these discrepancies are reported in this study.

Clinac- x-  
40 × 40 20 × 20 10 × 10 23EX  
Clinac- 6  
( ) 23EX  
3 WELLHOFER WP700

MCNP4B2

7%

:

( ) ×-

MCNP4B2

Waveguide

EGS4 (Briesmeister, 1997) MCNP

(Nelson *et al.*, 1985)(Rogers *et al.*, 1995; Ding, 1995; Sheikh-Bagheri *et al.*, 2000- and Mora *et al.*, 1999)

(Hartmann-Siantar *et al.*, 2001)

(Rogers *et al.*, 1995) BEAM/DOSXYZ

PEREGRINE (Hartmann-Siantar *et al.*, 2001)

(Ding, 2002)

:

Los Alamos

Monte Carlo "

Gambling House

Monaco

Nuclear Particles Transportation

Individual Particles Histories "

Simulated

Random Numbers

.Geometry

Deterministic Methods

:  
.Time Consuming  
Exact Solution

:  
Updated Nuclear Data

:  
.Integrated Tiger Series Codes (ITS3) "Tiger "  
Electron-Gamma Shower (EGS4) -

.Monte Carlo Neutron Photon

Transport Code (MCNP)

1976

.(Briesmeister, 1997)

MCNP

.3-D

" "

)

(Mean Free Path (mfp)

) Capture

.(

)

(

X' Flux

X'

$$X' = \frac{1}{N} \sum_{n=1}^N X_n$$

( )

N n<sup>th</sup>

X<sub>n</sub>

X'

.X'

$$\frac{1}{\sqrt{N}}$$

( )

Tallying Region

.(Hendricks, 1997) Variance Reduction Techniques

Wellhofer WP700

. 0.5 ≥

. 3

IC-10

(Almond *et al.*, 1999) TG-51 AAPM

.(Andreo *et al.*, 2000) IAEA

.( 48 × 48 × 48)

(3) (1)

- Clinac-23EX

6 MV

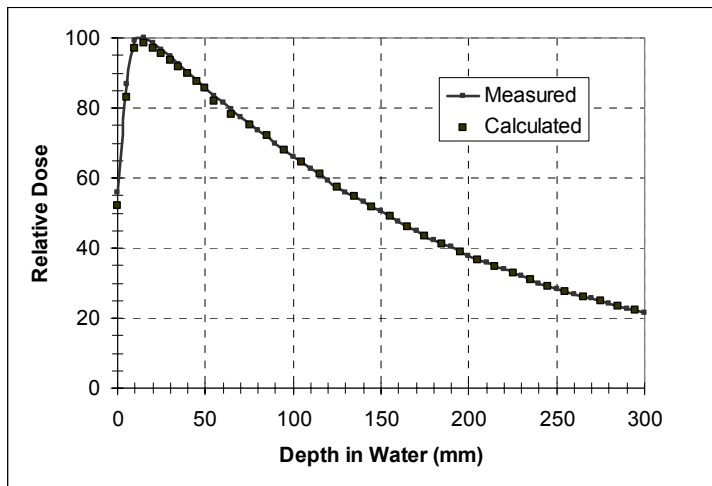
40 × 40 20 × 20 10 × 10  
100 (SSD)

MCNP4B2

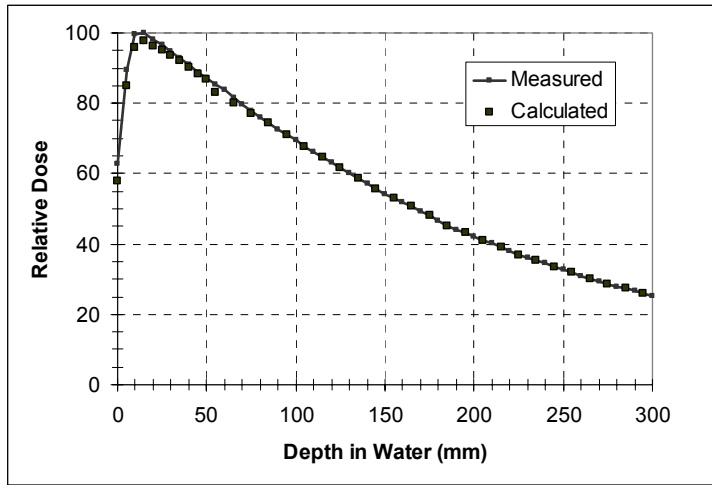
:(1)

100 = SSD

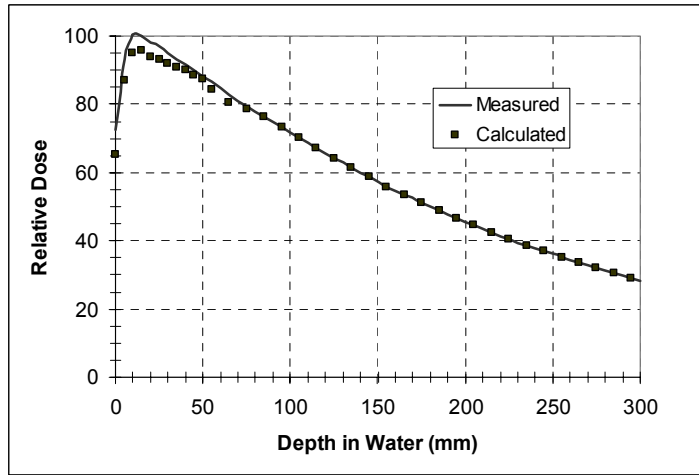
10 × 10



(2)  
 100 = SSD      20 × 20

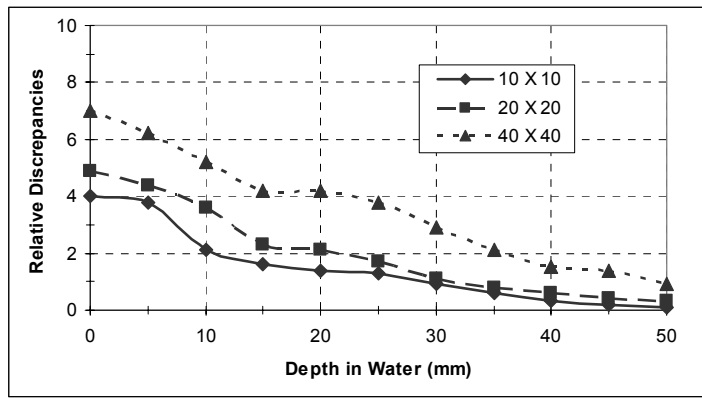


(3)  
 100 = SSD      40 × 40



(4)  
 )      50  
 40 × 40      7      ( =  
 50

:(4)



Clinac-

x-

23EX

(Hartmann-Siantar *et al.*, 2001)

(Ding, 2002)

18 MV

2 1

BEAM

EGSnrc/DOSRZnrc EGS4/DOSXYZ

6 MV

MCNP4B2

(Ding, 2002)

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