6.9. Worksheet

Determination of the absorbed dose to water in a high-energy photon beam

User: _____ Date: _____

1. Radiation treatment unit and reference conditions for $D_{w,Q}$ determination

Accelerator: _____ Nominal Acc Potential: _____ MV

Nominal dose rate: _____ MU min^{-1} Beam quality, Q ($TPR_{20,10}$): _____

Reference phantom: water Set up: ☐ SSD ☐ SAD

Reference field size: 10x10 cm x cm Reference distance (cm): _____

Reference depth z_{ref}: _____ g cm^{-2}

2. Ionization chamber and electrometer

Ionization chamber model: _____ Serial no.: _____

Chamber wall material: _____ thickness: _____ g cm^{-2}

Waterproof sleeve material: _____ thickness: _____ g cm^{-2}

Phantom window material: _____ thickness: _____ g cm^{-2}

Absorbed-dose-to-water calibration factor [a] N_{D,w,Q_o} = _____ ☐ Gy nC^{-1} ☐ Gy rdg^{-1}

Calibration quality Q_0: ☐ ^{60}Co ☐ photon beam Calibration depth: _____ g cm^{-2}

If Q_0 is photon beam, give $TPR_{20,10}$: _____

Reference conditions for calibration P_o: _____ kPa T_o: _____ °C Rel. humidity: _____%

Polarizing potential V_1: _____ V Calibration polarity: ☐ +ve ☐ –ve ☐ corrected for polarity effect

User polarity: ☐ +ve ☐ –ve

Calibration laboratory: _____ Date: _____

Electrometer model: _____ Serial no.: _____

Calibrated separately from chamber: ☐ yes ☐ no Range setting: _____

If yes Calibration laboratory: _____ Date: _____

3. Dosimeter reading [b] **and correction for influence quantities**

Uncorrected dosimeter reading at V_1 and user polarity: _____ ☐ nC ☐ rdg

Corresponding accelerator monitor units: _____ MU

Ratio of dosimeter reading and monitor units: M_1 = _____ ☐ nC MU^{-1} ☐ rdg MU^{-1}

(i) Pressure P: _____ kPa Temperature T: _____ °C Rel. humidity (if known): _____%

$$k_{TP} = \frac{(273.2+T)}{(273.2+T_o)}\frac{P_o}{P} = _____$$

(ii) Electrometer calibration factor [c] k_{elec}: ☐ nC rdg^{-1} ☐ dimensionless k_{elec} = _____

(iii) Polarity correction [d] rdg at $+V_1$: M_+ = _____ rdg at $-V_1$: M_- = _____

$$k_{pol} = \frac{|M_+|+|M_-|}{2M} = _____$$

(iv) Recombination correction (two-voltage method)

Polarizing voltages: V_1 (normal) = _____V V_2 (reduced)= _____V

Readings [e] at each V: M_1= _____ M_2= _____

Voltage ratio V_1 / V_2 = _____ Ratio of readings M_1 / M_2 = _____

Use Table 4.VII for a beam of type: ☐ pulsed ☐ pulsed-scanned

a_o = _____ a_1 = _____ a_2 = _____

$$k_s = a_0 + a_1\left(\frac{M_1}{M_2}\right) + a_2\left(\frac{M_1}{M_2}\right)^2 = _____$$ [f, g]

Corrected dosimeter reading at the voltage V_1:

$M_Q = M_1\ k_{TP}\ k_{elec}\ k_{pol}\ k_s$ = _____ ☐ nC MU^{-1} ☐ rdg MU^{-1}

4. Absorbed dose to water at the reference depth, z_{ref}

Beam quality correction factor for user quality Q: k_{Q,Q_o}= _____

taken from ☐ Table 6.III ☐ Other, specify: _____

$$D_{w,Q}(z_{ref}) = M_Q N_{D,w,Q_o} k_{Q,Q_o} = _____ \text{ Gy MU}^{-1}$$

5. Absorbed dose to water at the depth of dose maximum, z_{max}

Depth of dose maximum: z_{max} = _____ g cm^{-2}

(i) SSD set-up

Percentage depth-dose at z_{ref} for a 10 cm x 10 cm field size: PDD (z_{ref}=____ g cm^{-2}) =_____ %

Absorbed-dose calibration of monitor at z_{max}:

$$D_{w,Q}(z_{max}) = 100\ D_{w,Q}(z_{ref}) / PDD(z_{ref}) = _____ \text{ Gy MU}^{-1}$$

(ii) SAD set-up

TMR at z_{ref} for a 10 cm x 10 cm field size: TMR (z_{ref}=____ g cm^{-2}) = _____

Absorbed-dose calibration of monitor at z_{max}:

$$D_{w,Q}(z_{max}) = D_{w,Q}(z_{ref}) / TMR(z_{ref}) = _____ \text{ Gy MU}^{-1}$$

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[a] Note that if Q_o is ^{60}Co, N_{D,w,Q_o} is denoted by $N_{D,w}$.

[b] All readings should be checked for leakage and corrected if necessary

[c] If the electrometer is not calibrated separately set k_{elec} = 1

[d] M in the denominator of k_{pol} denotes reading at the user polarity. Preferably, each reading in the equation should be the average of the ratios of M (or M_+ or M_-) to the reading of an external monitor, M_{em}.

It is assumed that the calibration laboratory has performed a polarity correction. Otherwise k_{pol} is determined according to

rdg at $+V_1$ for quality Q_o: M_+ = _____ rdg at $-V_1$ for quality Q_o: M_- = _____

$$k_{\text{pol}} = \frac{\left[\left(|M_+| + |M_-|\right)/|M|\right]_Q}{\left[\left(|M_+| + |M_-|\right)/|M|\right]_{Q_0}} = _____$$

[e] Strictly, readings should be corrected for polarity effect (average with both polarities). Preferably, each reading in the equation should be the average of the ratios of M_1 or M_2 to the reading of an external monitor, M_{em}.

[f] It is assumed that the calibration laboratory has performed a recombination correction. Otherwise the factor $k_s' = k_s / k_{s,Q_o}$ should be used instead of k_s. When Q_o is ^{60}Co, k_{s,Q_o} (at the calibration laboratory) will normally be close to unity and the effect of not using this equation will be negligible in most cases.

[g] Check that $k_s - 1 \approx \dfrac{M_1/M_2 - 1}{V_1/V_2 - 1}$

[h] Note that if Q_o is ^{60}Co, k_{Q,Q_o} is denoted by k_Q, as given in Table 6.III.