7.10. Worksheet

Determination of the absorbed dose to water in an electron beam

User: _____ Date: _____

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

Accelerator: _____ Nominal energy: _____ MeV

Nominal dose rate: _____ MU min^{-1} Measured R_{50}: _____ g cm^{-2}

Reference phantom: ☐ water ☐ plastic obtained from ☐ ionization ☐ dose curves

Reference field size: _____ cm x cm Reference SSD: ____100____ cm

Beam quality, Q ($R_{50,w}$): _____ g cm^{-2} Reference depth $z_{ref,w} = 0.6\ R_{50} - 0.1$:_____ g cm^{-2}

2. Ionization chamber and electrometer

Ionization chamber model: _____ Serial no.: _____ Type: ☐ pp ☐ cyl

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

Waterproof sleeve / cover 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 ☐ electron beam Calibration depth: _____ g cm^{-2}

If Q_0 is electron beam, give R_{50}: _____ g cm^{-2}

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. Phantom

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

Plastic phantom phantom material: _____ density: _____ g cm^{-3}

depth scaling factor c_{pl}: _____ reference depth $z_{ref,pl} = z_{ref} / c_{pl}$: _____ g cm^{-2}

fluence scaling factor [b]: h_{pl} = _____

4. Dosimeter reading [c] 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 [d] k_{elec}: ☐ nC rdg^{-1} ☐ dimensionless k_{elec} = _____

(iii) Polarity correction [e] 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 [f] 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 = _____

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

Corrected dosimeter reading at the voltage V_1:

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

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

Beam quality correction factor for user quality Q:

If Q_o is ^{60}Co Table 7.III gives k_{Q,Q_o} = _____

If Q_o is electron beam Table 7.IV gives $k_{Q,Q_{int}}$ = _____ $k_{Q_o,Q_{int}}$ = _____

$$k_{Q,Q_o} = \frac{k_{Q,Q_{int}}}{k_{Q_o,Q_{int}}} = _____$$

If k_{Q,Q_o} derived from series of electron beam calibrations k_{Q,Q_o} = _____

Calibration laboratory: _____ Date: _____

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

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

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

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

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

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

---

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

[b] If a water phantom is used set the fluence scaling factor h_{pl} = 1

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

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

[e] 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_- = _____

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

[f] 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}.