An international Code of Practice for the dosimetry of small static photon fields

An international working group, established by the IAEA in collaboration with AAPM and IPEM, is finalising a Code of Practice for the dosimetry of small static photon fields which will be published as an IAEA guidance document. The document structure contains an introduction explaining the aims and scope of the document, a chapter on the physics of small field dosimetry relevant to the recommendations, a chapter outlining the formalism and concepts behind the recommendations and two chapters describing the practical recommendations for reference dosimetry in machine-specific reference \((msr)\) fields and for the relative measurement of output factors in smaller fields. A number of appendices contain data for correction factors required in the dosimetry procedures, discussion of uncertainties, recommendations on the implementation of Monte Carlo simulations of small field correction factors and worksheets and examples.

The chapter on physics of small field dosimetry starts with a section on the physical characteristics of small fields and the problems associated with small field dosimetry which describes issues like the conditions that are generally regarded to define small fields, the definition of field size, the hardening of the energy spectrum with decreasing field size, beam quality specification and determination for small fields and the influence of small field conditions on detector response. An overview of existing technologies involving small fields is provided and a discussion of uncertainty requirements for small field dosimetry as compared to uncertainty requirements in broad beam reference dosimetry. A review of the development of absorbed dose standards for small fields is given as well as an overview of current practice in clinical dosimetry. Much of the material in this chapter is in line and consistent with IPEM Report 103 [1].

Chapter three outlines the formalism and concepts for reference dosimetry in non-standard machine specific reference \((msr)\) fields and for the measurement of field output factors. First of all the characteristics of a small field that need to be measured for applying the recommendations in the next chapters are described and discussed. These are the field size, lateral dose profiles, beam quality and lateral charged particle equilibrium range. The formalism follows the proposal of Alfonso et al. [2] and consists of a section on \(msr\) field dosimetry and a section on the measurement of output factors. For \(msr\) field dosimetry three approaches are recommended in order of preference:

(i) the use of an ionization chamber calibrated specifically for the \(msr\) field,

(ii) the use of an ionization chamber calibrated in a conventional reference field with a generic correction factor for the \(msr\) field,

(iii) the use of an ionization chamber calibrated in a conventional reference field with the product of a correction factor for a virtual reference field and a correction factor for the difference between the \(msr\) and virtual fields.

These approaches are illustratively summarized in the figure. For the third approach, procedures are provided for determining the beam quality index \((TPR_{20,10} or %dd(10)_{10})\) in non-reference conditions. For the measurement of output factors in small fields, formal expressions are given for connecting large field measurements using ionization chambers to small field measurements using high-resolution detectors such as diodes, diamond, liquid ion chambers, organic scintillators and radiochromic film. This so-called ‘daisy chaining’ method is expressed in a way consistent with the Alfonso formalism. Formal procedures for the derivation of absorbed dose to water from measurements in plastic phantoms are also given in this chapter as well as reference conditions for particular types of radiation generators.

Chapters four and five provide the practical implementation of the dosimetry recommendations for \(msr\) dosimetry and relative output factor measurements, respectively. Both start with an overview of suitable detectors and phantoms, followed by a section on the correction for influence quantities and a section describing practical step-by-step procedures for \(msr\) dosimetry and relative output factor measurements, respectively.

References
