

Small field absorbed dose to water determinations in LINAC MV photon beams during site visit authority control of radiotherapy

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Small field absorbed dose to water determinations in LINAC MV photon beams during site visit authority inspection of radiotherapy
Abstract for IAEA ICARO-3 2021

I. Jokelainen and P. Sipilä
Radiation and Nuclear Safety Authority (STUK)

Materials

As a part of an authority control of radiation therapy the doses calculated by hospital dose planning systems for small static fields in LINAC photon beams were verified by absorbed dose to water measurements during the STUK site visits inspections. The absorbed doses to water were determined by ionization measurements using ionization chambers and synthetic diamond as the detectors. The calibrations of 0,6cm³ Farmer-type ionization chamber PTW30013 and the used electrometer PTW UNIDOS E are traceable to calibration laboratory SSDL-Helsinki. The small volume (0,03 cm³) Pin-Point-type ionization chamber PTW31015 and diamond detector PTW60019 (0,004 mm³) were cross calibrated during the inspections with each hospital LINAC MV photon qualities with Farmer chamber as a reference instrument. The measurements were made in hospitals water phantoms (50cm x 50cm x50cm).

Methods

During the period 2015 –2019 a total of 1500 absorbed dose to water determinations performed as part of authority inspections of 45 linear accelerators in 13 Finnish radiotherapy centers photon radiation beams with different field sizes. The absorbed dose to water determinations were made in Varian and Elekta accelerator conventionally filtered beams (WFF: 6MV, 10MV, 15MV and 18MV) and in beams without flattening filter (FFF: 6MV and 10MV). For Farmer- and PinPoint-chamber the recombination corrections (k_{rec}) were determined for every accelerator photon qualities and the beam profile specific chamber volume averaging correction factors (k_{vol}) were determined for every accelerator FFF photon qualities.

All dose determination and dose plans were made with SSD 100 cm and in depth of 10 cm. The Pin-Point-chamber PTW31015 and diamond detector PTW60019 were calibrated in reference geometry (SSD 100 cm, FS 10x10 cm², depth 10 cm) for all measured photon energies of every used LINAC. Dose plans were calculated for field sizes from 30x30 cm² to 2x2 cm². Farmer-type chamber was used for dose determinations in fields from 5x5 cm² to 30x30 cm², PinPoint chamber and diamond detector in fields from 2x2 cm² to 10x10 cm².

Results

Most of the dose plans were in good agreement with doses measured by STUK to be within ± 2 %. In one hospital the dose deviation exceeded the STUK acceptance criteria (± 3 %) with field sizes 4x4 cm², 3x3 cm² and 2x2 cm² in 6 MV beam and with 2x2 cm² field size in 15 MV beam, having max. deviation of 7 % in 6 MV 2x2 cm² field. After updating the hospital dose planning system algorithm and the input data the deviation decreased below 4 %. The agreement with doses measured with cross calibrated diamond detector and PinPoint chamber was within 0,5 %, except for 2x2 cm² field size where the deviations of 1 % were found. The deviation in the calibration factors of cross calibrated diamond detector PTW60019 and ionization chamber PTW31015 in different LINAC beams having same nominal energy were within $\pm 0,6$ %.

Conclusion

For verifying the input data of hospital dose planning system the absorbed dose to water measurements during the authority site visits with field sizes below 10x10 cm² has been found useful. The synthetic diamond detector having small energy dependence in LINAC MV beams has been found suitable cross calibrated detector for small field dosimetry with field sizes down to 2x2 cm², and PinPoint ionization chamber PTW31015 down to 3x3 cm².

Country or Int. Organization

Finland

Affiliation

Radiation and Nuclear Safety Authority

Primary authors: Mr JOKELAINEN, Ilkka (Radiation and Nuclear Safety Authority); Mr SIPILÄ, Petri (Radiation and Nuclear Safety Authority)

Presenter: Mr JOKELAINEN, Ilkka (Radiation and Nuclear Safety Authority)

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