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Small field absorbed dose to watwr determinations in LINC 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

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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 cham-ber 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 radia-tion beams with different field sizes. The absorbed dose to water determinations were made in Vari-an 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 (krec) were determined for every accelerator photon qualities and the beam profile specific chamber volume averaging correction factors (kvol) were determined for every acceler-ator FFF photon qualities.
All dose determination and dose plans were made with SSD 100 cm and in depth of 10 cm. The Pin-Poin-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 algo-rithm 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 were 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 ±0,6 %.

Conclusion
For verifying the input data of hospital dose planning system the absorbed dose to water measure-ments during the authority site visits with field sizes bellow 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

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