AU9716720

ADVANCES IN ABSORBED DOSE MEASUREMENT STANDARDS AT THE AUSTRALIAN RADIATION LABORATORY

John F Boas, Neville J Hargrave , Robert B Huntley,
Lew H Kotler, David V Webb and Keith N Wise
Australian Radiation Laboratory, Lower Plenty Road, Yallambie, Victoria, 3085

The applications of ionising radiation in the medical and industrial fields require both an accurate knowledge of the amount of ionising radiation absorbed by the medium in question and the capability of relating this to National and International standards. The most useful measure of the amount of radiation is the absorbed dose which is defined as the energy absorbed per unit mass. For radiotherapy, the reference medium is water, even though the measurement of the absorbed dose to water is not straighforward. The most common practice is to use ionisation chambers calibrated in terms of this quantity, where the calibration can be traced to a National primary standard of absorbed dose or of the alternative quantity, exposure. National standards are related to international standards by intercomparisons between primary standards laboratories under the umbrella of the BIPM. The responsibility for the maintenance of theAustralian primary standard of absorbed dose is in the process of being transferred from ANSTO to ARL, which already holds responsibility for the primary standard of exposure.

Two methods are commonly used to provide calibrations in absorbed dose to water. The first is the calibration of the chamber in terms of exposure in a Cobalt-60 beam, followed by the conversion by a protocol into dose to water in this and higher energy beams. The protocol recommended for use in Australia is that due to the IAEA, namely TRS-277. The other route is via the use of a graphite calorimeter as a primary standard device, where the conversion from absorbed dose to graphite to absorbed dose in water is performed either by theoretical means making use of cavity ionisation theory, or by experiment where the graphite calorimeter and secondary standard ionisation chamber are placed at scaled distances from the source of the radiation beam (known as the Dose-Ratio method).

Extensive measurements have been made at Cobalt-60 at ARL using both the exposure and absorbed dose to graphite routes. Agreement between the ARL measurements and those based on standards maintained by ANSTO and NPL is within ± 0.3%.

Absorbed dose measurements have also been performed at ARL with photon beams of nominal energy 16 and 19 MV obtained from the ARL linac. A comparison of the calibration factors for absorbed dose to graphite with those obtained by NPL for the same four secondary standard ionisation chambers gives agreement to better than ± 0.5% in these beams. The calibration factors obtained in terms of absorbed dose to water are also in reasonable agreement with those obtained at NPL and with those obtained from measurements in Cobalt-60 beams and the application of protocols. The results enable us to discuss the validity of the protocols at high photon energies, the validity of the methods used to convert from absorbed dose in graphite to absorbed dose in water and the validity of the indices used to specify the beams.

Brief mention will also be made of the establishment of a calibration facility for neutron monitors at ARL and of progress in the development of EPR dosimetry.