Australian Government
Australian Radiation Protection and Nuclear Safety Agency

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Australian Clinical Dosimetry Service

kV Level Ib Audit Fact Sheet and Instructions

Definition

The ACDS kV Level Ib Audit determines the dose rate in terms of absorbed dose to water on the surface of a full-scatter water phantom ($D_{w,z=0}$), for kilo-voltage photon radiotherapy beams, in accordance with AAPM's TG-61 Protocol[1]. Dosimetry measurements are made with a reference class electrometer with ionisation chambers for superficial (<100 kV) outputs (plane-parallel type PTW 23344) and orthovoltage (70-300 kV) outputs (Farmer-type PTW 30013). All measurements are made in-air. The ACDS uses Secondary Standard ion chamber air kerma calibration factors determined in low (10-100 kV) and medium (40-300 kV) energy X-rays, as recommended by the code. This audit is conducted by ACDS representatives, on-site at the Facility. The audit will require 5-7 hours of kV machine time on the day of the audit.

Audit Coverage

The kV Level Ib audit will be offered for new machine and/or tube installations as fee for service. The audit is designed to measure kV reference dosimetry on all superficial and orthovoltage radiotherapy beams on all machine model types.

Audit Scope

The ACDS aims to ensure a high degree of independence from the Facility by providing external equipment and measurements whenever practicable. The ACDS will however assume that:

- The machine has been accepted from the supplier by the Facility
- The machine has been commissioned by a certified ROMP (or equivalent) and performance (Mechanical and Radiation) is within facility tolerance on the day of measurement

The kV Level Ib audit will consist of the following measurements:

- Reference Dosimetry for clinical kV beams up to 300 kV for up to 3 cones
  - Using PTW 30013 (Farmer-type) and PTW 23344 (Plane-Parallel) chambers
- Optional spot-check HVL measurement for one or more kV beam using ACDS Al/Cu absorbers
- Equipment intercomparisons of the ACDS and Facility thermometer and barometer

CPD

Radiation Oncology Medical Physicists participating in the audit may claim 5 ACPSEM CPD points and 1 Optional Reflective point.

ACPSEM CPD Endorsed Activity

Certificates will be issued with the audit report.

Audit Outcome

The Audit results are determined by the percentage deviation of the Facility-Stated Dose Output from the ACDS-Determined Dose Output, for each clinical beam based on clinical tolerance levels. Outcome Levels are given in Table 1. An overall Audit Outcome is determined, which is equal to the lowest result recorded for an individual beam.

Table 1. General audit pass criteria

Indicative Outcome	% Deviation (Facility-Stated Dose Output / ACDS-Determined Dose Output)
	kV Photons
Pass (Optimal Level)	≤ 3.5
Pass (Action Level)	> 3.5 and ≤ 5.0
Out of Tolerance	> 5.0

Outcome Reporting

A kV Level Ib audit report is created for each individual machine audited. If required by the facility, an ACDS representative will issue preliminary results to the Facility immediately following the audit. The formal audit report will be sent to the Facility within two working weeks of the audit. This timeline will extend if additional information or follow up of non-optimal audit results are required.

Out of Tolerance results are promptly communicated to the Chief Physicist and reviewed by the Clinical Advisory Group. Data collected is held confidentially by the ACDS and its oversight groups. Publicly reported outcomes are randomised and de-identified.

The Australia and New Zealand (ANZ) Dataset is comprised of an extensive number of data points and information collected while developing, executing, and analysing ACDS audits. This comparative data is available for benchmarking the Facility's audit results against measured audit data for all modalities in the kV Level Ib audit and will be included in the formal report.

Facility Audit Procedures

- Ensure the dose outputs for kV photons (the absorbed dose per MU or unit time at DOSP, under reference conditions $D_{w,z=0}$) are available for the day of the audit per cone and beam combination being audited.
    - The dose output should be measured according to the Facility's routine physics output check (NOT Daily QA device).
    - DOSP = Dose Output Specification Point, the point at which the nominal dose calibration is specified by the Facility e.g. 1 cGy/MU or dose/time.
- Ensure a physics representative is available for the duration of the audit to operate all Facility equipment and provide supplemental information if required.

References

1. Ma CM, Coffey CW, DeWerd LA, Liu C, Nath R, Seltzer SM, Seuntjens JP, AAPM protocol for 40–300 kV X-ray beam dosimetry in radiotherapy and radiobiology. Med Phys 28(6):868–893 (2001)