Australian Government
Australian Radiation Protection and Nuclear Safety Agency

arpansa

Australian Clinical Dosimetry Service

Level I OSLD Audit – Fact Sheet

Definition

The ACDS Level I Audit determines absorbed dose to water per monitor unit for Mega-Voltage Photon and Electron beams under reference conditions. Optically Stimulated Luminescence Dosimeters (OSLD) are sent by post to the Radiation Oncology Facility (Facility). The OSLDs are irradiated by the Facility physicists and returned to the ACDS for processing.

Audit Coverage

The Level I Audit is available to all facilities as part of a scheduled program. All clinical Linacs in a facility are tested.

Audit Scope

The ACDS aims to ensure a high degree of independence from the Facility by providing external equipment for measurements where practicable. The ACDS assumes that the Linac has been accepted from the supplier by the Facility and has been commissioned by the responsible medical physicist and performance (Mechanical and Radiation) is within the tolerances defined by the Facility on the day of measurement.

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.

619 Lower Plenty Road, Yallambie VIC 3085
+61 3 9433 2220
acds@arpansa.gov.au
arpansa.gov.au/acds

Audit Outcomes

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. All beams on each Linac are tested unless the Facility states that a beam is "Not Clinical". Current Result Levels are given in Table 1.

Result	Level	% Deviation (Facility stated dose / ACDS measured dose)		mm Deviation (Facility – ACDS)
		Photons	Electrons D_{max}	Electrons R_{50} (6-16 MeV)
Pass	Optimal	≤ 2.6	≤ 3.4	≤ 2.4
	Action	> 2.6 and ≤ 3.9	> 3.4 and ≤ 5.1	> 2.4 and ≤ 3.6
Out of Tolerance		> 3.9	> 5.1	> 3.6

Table 1. General audit pass criteria

An overall Audit outcome for each Linac is determined, which is equal to the poorest result of any individual beam.

Outcome Reporting

A formal report will be sent to the Facility within approximately one month of the audit. A minimum fading time of at least one week is required before the OSLDs can be processed. The OSLD kits are processed in quarterly batches for multiple facilities at a time. This means the reports can be received one to two months after kits are returned.

General Audit Procedures

For the ACDS Level I audit, OSL detectors are mailed to the facility enclosed in PMMA blocks. Each photon beam has a designated block with two OSLDs positioned side by side at approximately d_{max}. The photon block is placed on a platform to reduce scatter effects from the table. The platform is not necessary for electrons as the electron block provides full scatter. The electron block consists of three stacked outer rings and a central acrylic plug containing the OSLD. Each electron beam has a designated central plug with one set of OSLDs near d_{max} and one set in the linear fall-off region between 80% and 30% depth dose.

For both photon and electron audits the facility delivers 100 MU to the OSLD block. For each energy, the facility states the absorbed dose to water that would have been delivered to the dose output specification point (DOSP) if the 100 monitor units had been delivered to a water phantom under the facility's reference conditions. This determination should include the daily output variation, as determined by the Facility's routine protocol for weekly/monthly output checks. At the time of measurements a Facility representative should complete, sign & date the ACDS form for this, which is included in the audit kit. The ACDS places no requirement on determination of the stated dose output. However to achieve the best possible comparison it is recommended the measurements be performed with an ionization chamber and ultimately be traceable to the local reference dosimetry.

All irradiations are required to be performed in the clinically used Linac mode, not "Physics" or "Service" modes. The Record & Verify (R&V) system may be left in stand-by mode for these measurements.

The OSLD dose under audit conditions, D_{audit}, is corrected to dose under facility reference conditions, D_{ref}, by a Block Factor, BF. The Block Factor is defined as the ratio of the dose to the OSLD under reference conditions to the dose to the OSLD under audit conditions.

$$D_{ref} = D_{audit} \times BF$$

The BF was determined by Monte Carlo modelling the OSLDs in the audit blocks and in a water phantom for a range a photon and electron beams. The BF for a facility beam is determined by interpolating the modelled BF with the facility stated $TPR_{20,10}$ or R_{50}. The OSLDs in the linear fall-off region of electron beams are used to measure the facility R_{50}. The facility R_{50} is determined using the modelled relationship between BF and R_{50} and interpolating the measured BF.

The irradiated OSLDs are read out between one week and one month post-irradiation. The raw PMT count is converted to dose, D_{audit}, according to:

$$D_{audit} = Counts \times ECF \times S \times k_E \times k_L \times kf$$

ECF is the individual element correction factor defined as the ratio of the mean batch counts, after 100 cGy irradiation, to the individual OSL counts, after 100 cGy irradiation.

S is the batch sensitivity, in cGy/counts, to 100 cGy of 6 MV photons.

k_E is the energy correction to account for the slight energy dependence in OSLD response relative to 6 MV photons.

k_L is the non-linearity correction to account for the non-linear sensitivity of the OSLD, normalized to the sensitivity at 100 cGy.

k_f is the fading correction to account for the reduced signal that occurs between irradiation and readout date.