Introduction
The Health Protection Agency for some years held approval to use its body TLD as an eye dosemeter for photons only\(^1\). The TLD is worn on the collar. It does not measure \(H_p(3)\) directly but uses an average of the \(H_p(0.07)\) and \(H_p(10)\) readings. Such usage relies on uniformity of the photon field in the vicinity of the head.

Recent developments in understanding have led the International Commission on Radiological Protection (ICRP)\(^2\) to recommend a dose limit of 20 mSv in a year, averaged over defined periods of 5 years, with no single year exceeding 50 mSv. We therefore anticipate a need for an eye lens dosemeter that will measure \(H_p(3)\) in uniform and non-uniform photon and beta fields.

The new design of eye dosemeter is based on a modified headband, using the Harshaw™ EXTRAD TLD element. This uses LiF:Mg,Cu,P which is tissue equivalent, and a PTFE filter of a tissue equivalent thickness of 3 mm, so enabling the measurement of \(H_p(3)\). This approach ensures that the dosemeter correctly measures the quantity in all fields and all mixtures of fields.

The tests were based on the ISO 12794\(^3\) standard and included energy and angular dependence of response for photons and betas. All were done on an ORAMED-designed cylindrical head phantom\(^4\) that we had built for this purpose. We used conversion coefficients for \(H_p(3)/K_a\) (where \(K_a\) is air kerma) that were derived from the monoenergetic values calculated for the same ORAMED project\(^5\).

Results
The results show that the performance of this eye lens dosemeter is good, for both photon and beta radiations.

\[
\frac{R}{R^{[^{137}Cs]}}
\]

\begin{center}
\begin{tabular}{c c c c c c c c}
Energy, keV & 0 & 10 & 100 & 1000 \\
\hline
R & 1.2 & 0.8 & 0.6 & 0.4 & 0.2 \\
\end{tabular}
\end{center}

\[
\frac{R}{R^{[^{137}Cs]}}
\]

\begin{center}
\begin{tabular}{c c c c c c c c}
Angle & -80° & -60° & -40° & -20° & 0° & 20° & 40° & 60° & 80° \\
\hline
\frac{R}{R^{[^{137}Cs]}} & 0.2 & 0.4 & 0.6 & 0.8 & 1.2 & 1.0 & 0.8 & 0.6 & 0.4 \\
\end{tabular}
\end{center}

Beta Energy Response (0°)
The relative response for \(^{90}Sr/^{90}Y\) is 1.10 and, as expected, there was zero response for \(^{85}Kr\). (Beta radiations from this radionuclide do not pass through 3 mm of tissue).

Conclusion
This headband using the Harshaw™ EXTRAD TLD element with a PTFE filter of a tissue equivalent of 3 mm would be suitable to use in the HPA’s approved dosimetry service. A potential enhancement to the design would be to improve the angle dependence of the beta response by making it more symmetric.

References
\(^2\) ICRP Statement on Tissue Reactions, April (2011).