Energy fluence spectra of a clinical photon beam are required for treatment planning algorithms based on energy deposition kernels. Previously it was shown that the energy fluence spectrum could be extracted from the measured dose distribution in the dose buildup region. To minimize the influence of contaminating electrons, the depth dose is measured for a small field (6×6 cm^2). Depth doses for monoenergetic photon beams are calculated using Monte-Carlo, and used as basis functions in a Cimmino feasibility algorithm to determine the weights of the energy components of a clinical beam spectrum from measured depth dose values. The calculated attenuation properties in water for the derived photon spectra agree well with the measured narrow beam attenuation in water. The variations in the measured narrow beam attenuation characteristics in water as a function of distance from the central ray are used to evaluate changes in the off-axis energy fluence spectra. The softening in the spectra off-axis was evaluated by shifting (S) each energy component (E) of the derived central ray cumulative energy fluence spectrum by

$$S(E,r)=A(r)\,(1-E/E_{MAX}),\ \text{with}\ A(r) = [e_{AVE}(r) - e_{AVE}(0)\,]\,[(1- e_{AVE}(0)/E_{MAX})\,]$$

where E_{MAX} is the maximum photon energy in the spectra on the central ray, $e_{AVE}(0)$ and $e_{AVE}(r)$ are the mean photon energy of the beam on the central ray and at a distance r off-axis respectively. These mean energies were obtained from the measured narrow beam attenuation coefficient μ as a function of distance from the central ray.