We have investigated a method to derive electron and photon energy spectra from measured beam data for Monte Carlo treatment planning dose calculation. The PDD curves of 6, 12 and 20 MeV electron beams obtained from Monte Carlo full phase space simulations of the Varian linear accelerators have been used to test the method. We have employed a “random creep” algorithm to determine the energy spectra of electrons and photons in a clinical electron beam. The fitted electron and photon energy spectra have been compared with the corresponding spectra obtained from the Monte Carlo simulations. Our fitted energy spectra are in good agreement with the Monte Carlo simulated spectra in terms of peak location, peak width, amplitude and smoothness of spectrum. In addition, the derived depth dose curves of head generated photons agree well in both shape and amplitude with those calculated using the full phase space. The central axis PDDs and dose profiles at various depths calculated using Monte Carlo simulated phase space spectra and those calculated using the fitted spectra agreed to within 1%/1 mm. The electron cutout factors calculated with the fitted spectra are within 2% of the measurement and those calculated using the Monte Carlo phase space. The comparison has demonstrated that our method is capable of deriving the energy spectra of electrons and photons for the Varian linear accelerator electron beams investigated. We have implemented this method in the electron beam commissioning procedure for electron beam Monte Carlo treatment planning.