Both a benchtop and a prototype are being developed to investigate tomotherapy at the University of Wisconsin. The benchtop treatment head consists of a 4-MV linear accelerator and a NOMOS multileaf collimator (MLC). The prototype head is envisioned to consist of a 6-MV linear accelerator and a 64-leaf MLC. Using BEAM, an EGS4 Monte Carlo user code developed jointly with the National Research Council of Canada, models of both treatment heads have been built. The purpose of the benchtop model is to benchmark the Monte Carlo code with measurement data and to provide position-dependent spectra for input into a convolution/superposition dose reconstruction algorithm. The prototype model was developed to investigate several design issues: target thickness, collimator thickness, shielding, electron contamination sources, and the role of the septa in a multi-segmented megavoltage ion chamber. A percent depth dose comparison in a water tank between the benchtop measurements and Monte Carlo results are presented. In addition, the Monte Carlo spectra, fluence, energy fluence, and mean energy are presented for both models.