New treatment modalities such as conformal therapy and IMRT and inverse planning methods require accurate calculations of output factors and dose distributions of highly irregular radiation fields. A number of methods including kernel-based calculations, pencil beam models, and Monte Carlo have been used. However, all three are difficult to implement in a clinical setting. We report a practical, measurement-based dose calculation method that has proven to be highly accurate at calculating output factors and 3D dose distributions for intensity modulated plans as well as for conventional modalities. It is based on an extended source model and a finite-sized pencil beam TPR model as described by Hounsell et al [Hounsell AR, Wilkinson JM, Br J Radiol, 63: 629-634, 1990]. Instead of using Monte Carlo calculations to characterize the head scatter and phantom scatter, a set of exponential functions are fit to a series of measurements to obtain an empirical fit to the radiation transport. Both head and phantom scatter are calculated by breaking up the portal into volume elements of 1cm by 1cm cross-sectional area and by then summing the scatter contribution from each of these elements. The penumbra is characterized by an empirical fit to measurements. Inhomogeneities are treated by a scaling of primary radiation and phantom scatter by the radiological pathlengths for each beam element. Results are presented for 6 and 18 MV beams. Output factors, TPR’s, PDD’s, and off-axis doses are compared with measurements for a series of irregular fields with and without intensity modulation.