

AbstractID: 7405 Title: Reducing the frequency of linac output check: a statistical model of linac output fluctuation based on a 3 year history to evaluate new tolerances as a function of test frequency for 12 linear accelerators.

Purpose: The study is based on a formalism to model the fluctuation of 12 linac outputs during a 3 year period. From a semi-empirical statistical model and TG-40 recommendations, a QA program is built from calculated action levels as a function of test frequency and time-dependant probability distributions.

Method and Materials: The linac output data is analyzed to fit a statistical model taking into account a systematic and a random component in the daily fluctuation. A 3 year history of daily output measurements totalizing 71 independent energies of photons and electrons is used to evaluate the parameters in each model. Action levels are calculated as a function of test frequency from obtained models based on tolerances defined in TG-40. A confidence level of 95% is used to define the QA program such that machine output is kept within given limits, the latter being obtained by fitting tolerance functions with TG-40 action levels. Measurement uncertainties are taken into account in the model and Gaussian statistics are used in the formalism.

Results: Comparison between models and data history are in agreement with Gaussian statistics. For each linac and energy, tolerance functions are obtained from data history and new action levels are used with reduced test frequency. The tolerance of 2% recommended by TG-40 for monthly output constancy check is reduced to values ranging from 1.2% to 1.8% for a test frequency of two months. Linac calibration frequency is reassessed to values ranging from 4 to 12 months.

Conclusion: While daily check should be kept constant to prevent unpredictable variations, the frequency of output check can be reduced using new action levels based on a program-defined limit and confidence level. Probability distributions can be used to evaluate linac calibration frequency based on machine stability. The model can be extended to other linac parameters.