Mathematical Analysis of the On Bore Sight Energy Characteristics of the Radiation Field of the Impulse Radiating Antenna

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This report provides a mathematical analysis of the energy characteristics of the radiation field from an impulse radiating antenna (IRA) on bore sight. The IRA is generally known for its Delta function waveform generated on bore site at large distances (kilometers) from fast rise time (sub-nanosecond) voltage waveforms. With a Delta function waveform, the radiation field on bore sight should be infinite and allow for an infinite amount of energy to be deposited. In reality, the field and energy are only very large and should be measurable and calculable. In a series of recent papers (I. Kohlberg and I. Chappell, UWBUSIS, Sevastopol, '06, I. Kohlberg and C. Baum, ICEAA, Torino, '05) we described the analytic solutions for all the electromagnetic fields produced by an IRA for general source voltage waveforms. The fields are calculated in three dimensions in the frequency and time domains by using Fourier Transform and Maxwell's Equations. By looking at a small region around the bore sight, a measure of the energy deposited will be calculated as a function of the solid angle around the axis. This calculation will analyze approximations of the Delta-function waveform in this region and determine the limits of the maximum amount of energy that can be deposited. This is useful to assess the effectiveness of an IRA antenna for depositing large amounts of energy in a specific location and should be usable to compare with measured values in future experiments. Different waveforms and rise times will also be investigated for possible improvements to the energy depositing properties of the IRA antenna.