Variation of E1 HEMP and IEMI Coupling Using IEC 61000-2-9

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Abstract— The coupling of E1 HEMP incident electric fields to horizontal and vertical cables is dependent on the polarization and angle of incidence relative to the cable as well as the cable and ground parameters and peak incident electric field. This presentation will show the statistical distributions that result when the variations in the coupling parameters are made using the IEC 61000-2-9 specification for the incident electric field, and use a flat distribution determined for the polarization and incidence angle.

Keywords-E1 HEMP, IEMI, cable coupling.

I. INTRODUCTION

In a presentation at ASIAEM 2017, we showed statistical distributions for typical HEMP E1 coupling to horizontal cables, where the statistical distribution has correlations between the incidence angle and polarization determined by the height of burst and the magnetic field dip angle. These correlations result from the physics of the field generations. The weight of angles of incidence of the statistical distribution was taken from a uniform weight of burst locations for which the observer was in the line of sight, and the electric field polarization was determined by the turning of the Compton electron in the HEMP source region. For the chosen mid-latitude burst, this made some combinations of polarization and incidence angle nonexistent.

II. PROBABILITY DISTRIBUTIONS

In this presentation, we will examine the statistics which result from using a distribution of incident wave Poynting vectors that are uniform over the downgoing hemisphere, and, for each Poynting vector, a uniform distribution of perpendicular polarization vectors.

This distribution has a lower probability of low angles of incidence than that used in the previous work, and more probable fields with near-vertical field polarization

II. INCIDENT FIELDS

The incident E1 is taken from IEC 61000-2-9 with a peak field of 50 kV/m.

$$E = E_0 K(e^{-\beta t} - e^{-\alpha t}) \quad (1)$$

Where E_0 is the peak field, K is a normalizing constant and α and β are the rise rate and fall rate respectively. The IEC HEMP pulse has rise and fall times of 2.5 and 23 ns. For short cables, only the effect of E_1 needs to be taken into account. For the IEMI field, we use a pulse which has a factor of 10 greater rise and fall rates.

IV. PARAMETER VARIATIONS

In this presentation we will show the probabilities of coupling from E1 HEMP and IEMI fields to short cables inside poorly shielded buildings . showing the variation for coupling to a 1, 3, and 10 meter length horizontal cables at varying heights and vertical cables of the same length. The results are shown as probability cumulative distribution functions (CDFs) showing the probability of peak current greater than the corresponding value on the horizontal axis.

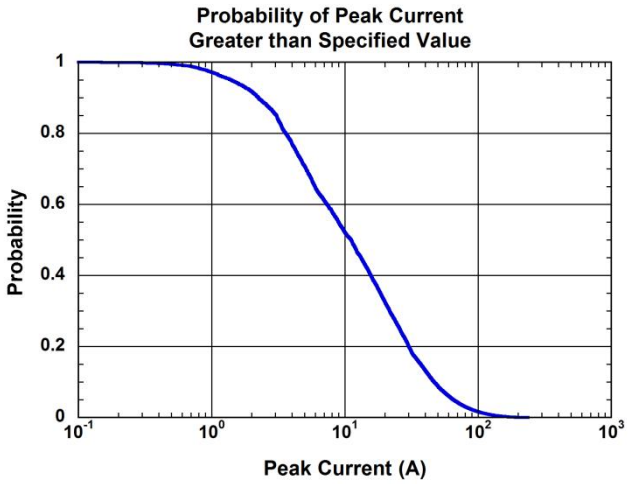

Figure 1. CDF of peak current on horizontal line.

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