Methodologies Applied for Modeling and Analysis of Impulsive Grounding Systems – A Study Review

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Abstract

Grounding systems are one of the main resources capable of keeping the physical integrity of an installation in the event of a lightning discharge. Grounding schemes are also an important system for population security [1]-[2].

The human tolerable step and touch potentials usually are considered as reference parameters only on the steady-state/low frequency ground mesh analysis, however such potentials can be exceeded in the transitory period of an electric impulse as lightning surges. In this way, impulsive analysis during the transitory period must be evaluated [3].

In the occurrence of a lightning surge, grounding systems are responsible for electric current conduction to the ground. In this phenomenon, the grounding mesh impedance must be less than the equivalent impedance of the remaining electrical system, elsewhere, the electric discharge will flow to the system causing severe physical and material damages.

Models development for suitable grounding systems can provide the necessary knowledge for the construction of more efficient ground meshes. More efficient grounding meshes allow a security and quality increase of the electrical power system operation [4].

The impulsive and high frequency analysis of grounding systems traditionally is made by the solution of the Maxwell equations. Such methodology, already known and consolidated is based on the solution of a set of differential equations that represent the grounding, earth and electrode. However, grounding systems physical characteristics modeling with consequent mathematical solution of differential equations is not a trivial task [5]-[6].

In recent years, other numerical and analytical methodologies had been developed and adjusted for grounding systems analysis. The Finite Element Method (FEM) [7], the Moments Method (MoM) [8]-[9], the Transmission Line Approach methods integrated in transient analysis programs [10], and the Transmission Line Modeling Methods (TLM) [11],[12],[13] are some of the most important ones. The TLM is between the most studied and developed in these recent years, being able to be used for Maxwell equations resolution for electromagnetic waves propagation. Complex geometries, non-homogeneous medium with losses, materials with changeable parameters can be modeled with the TLM.

In this context, the goal of this paper is to present a study review of the main applicable methodologies used for impulsive analysis of grounding systems, emphasizing its characteristics, advantages and disadvantages.

Key words:

Impulsive grounding systems, transient analysis, numerical and analytical techniques, lighting.

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