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EMTP-RV Analysis of Lightning Surges on Wind Turbines

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Abstract. This paper is concerned with lightning surge propagation on wind turbines. As wind power generation undergoes rapid growth, lightning incidents involving wind turbines have come to be regarded as a serious problem. Nevertheless, no known studies exist yet in Portugal regarding lightning protection of wind turbines. Hence, we present a case study, based on a wind turbine with an interconnecting transformer, for the analysis of lightning surges. Computer simulations obtained by using the EMTP-RV code are presented. Conclusions are duly drawn.

Key words

Lightning surge, transient analysis, wind turbine.

1. Introduction

The need to control climate changes and the increase in fossil-fuel costs stimulate the ever-growing use of renewable energies worldwide. Concerning renewable energies, wind power is a priority for Portugal's energy strategy. The wind power goal foreseen for 2010 was established by the government as 3750 MW and that will constitute some 25% of the total installed capacity by 2010 [1]. This value has recently been raised to 5100 MW, by the most recent governmental goals for the wind sector.

As wind power generation undergoes rapid growth, lightning incidents involving wind turbines have come to be regarded as a serious problem [2]. Lightning protection of wind turbines presents problems that are not normally seen with other structures.

Modern wind turbines are characterized not only by greater heights but also by the presence of ever-increasing control and processing electronics. Consequently, the design of the lightning protection of modern wind turbines will be a challenging problem [3].

The future development of wind power generation and the construction of more wind farms will necessitate intensified discussion of lightning protection and the insulation design of such facilities [4]. Nevertheless, no known studies exist yet in Portugal regarding lightning protection of wind turbines. Also, surge propagation during lightning strikes at wind farms is still far from being clearly understood. Thus, much work remains to be done in this area. Direct and indirect lightning strokes can produce damages of electrical and electronic systems, as well as of mechanical components such as blades and bearings [5]. Damages statistics of wind turbine components has been analyzed in the literature [6].

In this paper, we present a case study, based on a wind turbine with an interconnecting transformer, for the analysis of lightning surges. Computer simulations obtained by using the EMTP-RV code are presented, and conclusions are duly drawn.

References

[1] A. Estanqueiro et al., "How to prepare a power system for 15% wind energy penetration: the Portuguese case study", Wind Energy, Vol. 11, pp 75-84, 2008.
[2] Y. Yasuda et al., "Surge analysis on wind farm when winter lightning strikes", IEEE Trans. Energy Conversion, Vol. 23, pp 257-262, 2008.
[3] F. Rachidi et al., "A review of current issues in lightning protection of new-generation wind-turbine blades", IEEE Trans. Industrial Electronics, Vol. 55, pp 2489-2496, 2008.
[4] Y. Yasuda et al., "Analysis of lightning surge propagation in wind farm", Electrical Engineering in Japan, Vol. 162, pp 30-38, 2008.
[5] I. Cotton et al., "Lightning protection for wind turbine blades and bearings", Wind Energy, Vol. 4, pp 23-37, 2001.
[6] T. Sorensen et al., "Lightning protection for offshore wind turbines", Proc. 16th International Conference and Exhibition on Electricity Distribution, Amsterdam, Netherlands, 2001.