Some Aspects on Lightning Protection of Wind Turbines

V. Shostak1, W. Janischewskyj2, F. Rachidi3, A. Mosaddeghi3, M. Rubinstein4, and G. Kovenya1
1National Technical University of Ukraine, Ukraine
2University of Toronto, Canada
3Swiss Federal Institute of Technology (EPFL), Switzerland
4University of Applied Sciences, Switzerland

Abstract—In this research note, information is presented on studies connected to some aspects of lightning protection (LP) of wind turbines (WT), and on the use of related international and national (Ukrainian) standards.

Keywords—Earthling system, lightning protection, tall structure, wind turbine

Development of wind farms in many countries is accompanied with large losses due to direct lightning strikes, mostly to blades. With the tendency of increasing wind turbines power and, correspondingly, their dimensions (blades length, tower and total heights), the number of lightning strikes to such installations is rising too. This keeps the questions of studying lightning parameters at wind turbines [1], adequate protection measures [2], tests and standardization rather relevant [2-5].

The review of several important issues on LP of blades was recently presented in [2]. The present study emphasizes the need of taking into account the upward-initiated lightning, and discusses approaches used in the construction of the termination system and in-blade downconductors. Additionally, the questions on the use of related standards on WT, the selection of LP level, and the determination of LP zones and of earthing system parameters are considered.

During the last few years, several new 600 kW wind turbines (Turbowinds T600-48) were installed in Ukraine. The rotor of this turbine with the three blades has a diameter of 48 m and the tower is about 55-m tall. The blades are made of carbon-reinforced plastics. Initially they were equipped with metallic mesh strings under some surface layers of plastic covering, which served as receptors and downconductors for the lightning current. In the studied farms, several strikes to wind turbines occurred during these years and some blades were seriously damaged. Next-version blades were equipped on both sides with steel lightning terminations having a reception surface in one plane with the surface of the blade. Observations on lightning performance of blades are being continued.

Regarding standardization issues, only a few international standards directly related to LP of wind turbines were developed. Recently the work on updating the 2002 version of IEC 61400-24 was initiated (publication of its new version is planned for 2010). In Ukraine, there is only one standard related directly to LP of wind turbines – the officially harmonized Ukrainian translation version of IEC 61400-24: 2002. Some other Ukrainian standards and norms on wind farms and turbines have just small paragraphs connected to LP, and actually they contain some contradiction items in comparison to IEC 61400-24: 2002, namely, on the selection of the lightning protection level (while in [4] the recommended level is I or II, in Ukrainian norms – III), calculations and arranging of the earthing system, normative requirements on grounding impedance (≤10 Ohm in [4] and 2 Ohm in [6]), and others.

It is shown, that the dimensions of the earthing system (for soil resistivities of ρ = 1500 and 150 Ohm·m), determined using the approach in [4], do not provide normative impedance values according to [4, 6], if these impedances are checked by using well-known expressions and simulation. Thus, the design of the WT earthing system requires a more accurate approach, which considers the WT reinforced foundation, and additional earthing ring and rod electrodes.

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REFERENCES