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Comparison Between High Intensity and Synoptic Wind for Lattice Transmission Towers

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ABSTRACT

Lattice towers, as the most prevalent tower system, play a major role in the high-voltage transmission line systems. Transmission lines are known to be vulnerable to High Intensity Wind (HIW) events, as evidenced by the numerous failure incidents which have been frequently reported worldwide following those events. HIW is generated by tornadoes and downbursts which are often associated with thunderstorms. An extensive research program was conducted at the University of Western Ontario during the past twenty years focusing on this subject. Numerical and analytical models were developed to simulate the tornado and downburst wind fields as well as the transmission lines structural performance under those events. These developments were validated using tests conducted at the Wind Engineering, Energy and Environment (WindEEE) facility which is capable of generating three-dimension wind field simulating tornadoes and downbursts. A major outcome of this research program was the development of genetic load cases simulating the critical effects of downbursts and tornadoes on transmission lines. These load cases were recently incorporated in the American Society of Civil Engineering transmission lines loading guidelines, ASCE-74 (2020). The objective of this study is to compare the effect of those new load cases to the typical load cases associated with synoptic wind and ice loads through a case study. A tangent self-supported lattice tower is considered in the study. The tower is analyzed first under the set of load cases of synoptic wind and ice specified in the ASCE-74 (2010). Two other sets of analysis are conducted under downbursts and tornadoes using the new ASCE-74 (2020) provisions pertaining to HIW. In these two sets of HIW analysis, the reference velocity of the HIW event is gradually increased. The tornado and downburst reference velocities at which the internal forces in the tower members start to exceed those produced by the typical load cases are reported. The study provides an insight about that vulnerability of transmission line structures to HIW events.

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