The Impact of Connecting a Wind Power Plant on Emergency Modes of a Traction Substation of an AC Traction System

Yurii Kachan[1], Vitaliy Kuznetsov[2](✉), and Oleh Bondar[3]

[1] Zaporizhzhia Polytechnic National University, 64, Zhukovsky Street, Zaporizhzhia 69063, Ukraine

[2] National Metallurgical Academy of Ukraine, Gagarina Avenue, 4, Dnipro, Ukraine
witjane20002014@gmail.com

[3] Dnipro National University of Railway Transport Named after Academician V. Lazaryan, Dnipro 49010, Ukraine

Abstract. Among the countries of South-Eastern Europe, Ukraine has the greatest technical potential for the implementation of renewable energy sources, and the main part of it is wind power engineering. The traction power supply system of the railways in Ukraine can become an important transiter and consumer of electricity generated by wind power plants. At the same time, the task of ensuring traffic safety and uninterrupted power supply of traction loads requires a preliminary study of the influence of the connected wind power plant capacity on the growing short-circuit currents in the distributive units of the traction substation to which the specified connection is planned. This paper proposes a way to implement such prediction based on a systematic approach, in which a traction substation and an integrated wind power plant are considered as a single electrical-engineering complex, the sources of which work to power the short-circuit point. In previously published studies, the authors usually consider the processes in renewable energy sources and in the traction power supply system separately, without taking into account the mutual influence. The analysis of processes in the short-circuit mode is proposed to perform according to the equivalent circuits for the specified electrical-engineering complex developed by the authors with various possible options for connecting a wind power plant using mathematical modeling with proven methods of theoretical electrical engineering. The peculiarity of the study presented in this paper is also the use of the multiplication factor of the short-circuit current as a criterion for assessing the impact of the power of the connected wind power plant on the short-circuit currents of the traction substation. In our opinion, the coefficient applied by us more clearly characterizes the specified influence in comparison with operating values or complex sizes of short-circuit currents.

Keywords: AC traction system · traction substation · Wind power plant · Increase in the short-circuit currents · multiplication factor

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