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WIELOTOROWE, WIELONAPIĘCIOWE ELEKTROENERGETYCZNE LINIE NAPOWIETRZNE WYSOKICH I NAJWYŻSZYCH NAPIĘĆ

MULTI-CIRCUIT, MULTI-VOLTAGE HVAC TRANSMISSION OVERHEAD LINES

PRACA DOKTORSKA

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Summary

Significant changes resulting from the ever-increasing demand for power and electrical energy and changes in the supply structure are constantly observed in the power system. Multi-circuit, multi-voltage overhead lines (MMOLs) are becoming a favorable solution in the perspective of ensuring the efficient transmission of electrical energy and limitations related to the expansion of the transmission network.

The main objective of the thesis was to analyze the benefits and problems raised by MMOLs and develop a universal mathematical model. The developed model represents MMOL in normal state operation (steady states) and disturbance state operation to determine the short-circuit currents (quasi-steady states).

The main part of the thesis contains the analysis of threats to power system operation due to asymmetrical MMOL, with a particular focus on the circuit with the lowest rated voltage. For this purpose, the electromagnetic field strength in the vicinity of the MMOLs, the voltage of the neutral point displacement in the network with the lowest rated voltage (zero voltage U_0) and the selected voltage quality factors were determined. Short-circuit analyzes were determined to examine the influence of differences between the use of exact and simplified mathematical models on short-circuit currents. Additionally, the impact of MMOL asymmetry on its nearest network operation was determined.

One of the objectives of the research was the possibility of increasing the maximum length of MMOLs, for which the permissible levels of the criteria values of the parameters are not exceeded by applying partial line symmetrization.

The presented results and conclusions confirm that the circuit with the lowest rated voltage is the most exposed to the effects of geometric asymmetry. The geometric asymmetry of the MMOLs significantly affects the selected voltage quality factors. Furthermore, its simplified mathematical model may lead to significant estimation errors of short-circuit currents in network systems.

From the point of view of external conditions of the system development, multi-circuit, multi-voltage lines are a very beneficial solution. The emerging unfavorable voltage and current unbalance that occur mainly in the circuit with the lowest voltage can be significantly reduced by simple technical operations, such as the selection of an appropriate silhouette in a pole, a change of the way of supplying individual circuits, or simple transpositions in the circuit with the lowest rated voltage.