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# Establishing parameters of very high voltage power lines for various loadings and atmospheric conditions

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ABSTRACT

The idea of establishing parameters of electro-power system elements under real conditions of work, and therefore of very high voltage power lines, was suggested at CIGRE congress of 1972. In Romania, I undertook the work on this applied research.

In the classical theory of the symmetrical quadrupole of a very high voltage power line, it was considered known its uniform distributed parameters and the magnitudes of its input values and its output values unknown. The problem arising is to determine its internal parameters when the input and output values are known. It was necessary to develop an adequate mathematical method for this purpose, and in the first part of the article I present it in detail.

The article presents an adequate way of measurement to reach this purpose, as well as the necessary cautions to do away with the possible errors of measurement, and a synthesis of the results obtained. It also presents one method for testing in laboratory, to double check the correctness of the results of the real high voltage line parameter measurements, because they seem to be abnormal, different from those previously considered as normal.

The results of the measured parameters obtained in the laboratory model confirm the results obtained on the real high voltage lines. Finally, I present the theoretically explanation of this results.



## 1. Introduction

The matter of establishing the parameters of the electric power system elements for the real operating conditions was brought up at the CIGRE session of 1972. To that end a 3 year experimental research was initiated with respect to the 110, 220 and 400 kV power lines as well as generators and transformers within the power system of Romania. The required methods for measuring and calculating parameters for such elements were prepared, then experiments commenced.

For transformers the results were identical to those for no-load and short-circuit tests, valid for all the transformers range from low power to high power and voltage ones.

Generator parameters were heavily dependent on the operating power level and substantially different from those observed in the no-load and short-circuit tests, though somewhat predictable.

For the 110 and 220 kV transport lines with one cable per phase some small though not notable deviations were observed from relation to the Carson–Polaczek equations. For lack of two cables per phase lines, no experiments were conducted for such lines.

For 400 kV lines with two cables per phase large differences were noted from the results obtained using the Carson–Polaczek equations. At the end of the research there was no explanation for such results though no errors of principle or practical experiment were detected. The conclusion reached was that such results could not be considered reliable. All possible explanations were exclusively related to the very high voltage of the lines. The results were always consistent even after 1000 measurements and calculations made.

As organizer of the research I was concerned with finding the exact cause of those results for more than 30 years and I now consider I have found the necessary explanation which is not entirely based on the very high voltage of the lines but on the dominant factor of the constructive structure of the line comprising two or more cables per phase.

The procedure, results and the new explanation are described.

### 1.1. Air power lines parameters

In order to consider all the factors influencing the operating line parameters I will describe the following adequate mathematic method designed so that, by measuring the physical quantities at the ends of the line, all parameters can be calculated. The voltage, current and active power rates per phase are known and the

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