

TRAVELING WAVES ON ELECTRIC POWER SYSTEMS

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The problems of traveling waves on the transmission lines of a power system¹ differ considerably from those of traveling waves on telephone or telegraph circuits. The primary object in the case of the former is to know how to protect the system from abnormal voltage disturbances which might damage apparatus or cause discontinuity of service; whereas the object in the case of the latter is the transmission of signals. Attenuation, distortion, wave shape modification, and successive reflections are deliberately sought after on the power system as a means of rendering the surges innocuous, but these effects must be carefully avoided or nullified on the communication circuits so as to preserve the wave shape and transmit the signal with strength, fidelity, and without interference. On the power lines, the surges often originate from unknown causes, or at the point of origin are of unknown magnitude and shape (except from a statistical point of view); while on the communication circuits the initial shape and magnitude of the wave train are known with exactness. External fields (due to charged clouds), corona, flashovers, faults, and so on are of great importance with respect to surges; but are of no concern in the normal functioning of a telephone or telegraph line. Thus on the power lines surges originate from external or undesirable causes and every effort must be made to withstand or control them; while on communication circuits the transients are the direct means to the end.

These differences have led to corresponding differences in the mathematical approach. The power engineer is satisfied with approximations which would be intolerable to the communications engineer, and he is willing to take a license with mathematical rigor which would make any self-respecting mathematician groan. Higher mathematics has found little or no application in the study of surges on power systems. This has been due primarily to the fact that the boundary conditions are not definite enough to justify purely mathematical refinements; particularly since engineering results must be obtained in a short time by men who are not mathematicians. However, there are numerous aspects of the problem which lend themselves to mathematical excursions. It is my purpose in this lecture to

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¹ *Traveling Waves on Transmission Systems*, L. V. Bewley, New York, Wiley.