DISCRETE MODELS OF THE ELECTRIC GRID ELEMENTS, OBTAINED WITH USING THE IMPLICIT GEAR METHOD

Lebedka S.M[1]., Veprik Yu.N.[2]
[1]***Sumy State University, Sumy;***
[2]***National Technical University «Kharkiv Polytechnic Institute», Kharkiv***

Experience has shown that the electric grids of 6-35 kV characterized by a fairly high probability of damage. The most frequent type of accidents in these networks appear ground faults. Ground faults are accompanied by intermittent burning arc, therefore, are the cause of transients and overvoltages on the network elements.

Ample opportunities for research of transients arising at operation of the electric power equipment systems and overvoltages are provided with modern computer facilities. For a sufficiently accurate analysis of computer processes occurring in ground faults, it may need a more complete mathematical models of electrical grids and their elements. The development of such models is possible on the basis of the equations in the phase coordinates. Their undoubted advantage is that these equations contain the parameters of the network elements (resistances, self and mutual inductance and capacitance) and the parameters of its regime (currents, phase voltages), which correspond to the real physical parameters of electrical systems.

The mathematical network model in the transient processes is a system of ordinary differential equations (ODE). Analysis of transient processes is reduced to the numerical integration of ODE system. For the numerical solution of ODE is advisable to use implicit methods of integration. Compared with explicit methods are more accurate, they have a much wider area of stability, allow you to select a larger integration step, significantly reducing the number of steps required to solve.

Differential equations of transient processes, using a fairly complete description of the elements of the electric network, characterized by a large spread of time constant, i.e., the presence in the decision as a “fast” and “slow” variables. Numerical integration of these “stiff” equations by traditional methods meets the certain difficulties. One of the methods to overcome these difficulties, a Gear method, which is based on the implicit multistep difference methods of high order accuracy.

Discrete mathematical model of the electrical grid elements prepared: transmission lines, two winding power transformer using a second-order formula of implicit Gear method. They approximate the initial differential equations that describe the network elements. The equations of the models solved for the phase currents in the current step of integration. Discrete mathematical models of electrical grid elements obtained using an implicit Gear method. Models are designed to create a system of nodal equations in step numerical integration. It decision allows to determine grid mode parameters on the current integration step by parameters in the previous steps.

The prospect of further development is the implementation of a computer obtained discrete models of network elements, modeling accidental of transient processes, overvoltage definition affecting the equipment of electric grids, research and evaluation of the effectiveness of using computational experiments of grids protection agents against overvoltage.