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METHOD OF DETERMINING THE TOUCH VOLTAGE IN A SYMMETRICAL NETWORK WITH VOLTAGE UP TO AND ABOVE 1000 V

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The mode of insulation damage of any phase of the network relative to the ground is typical for the internal power supply systems of enterprises.With a low level of operation of electrical installations, as well as with existing imperfections of single phase-to-ground fault protection devices, long-term operation of the network with a ground-fault mode occurs, which leads to an increase of probability of a person falling under the touch and step voltage. Since the touch voltage depends on the magnitude of the current of single phase-to-ground fault, and the latter depends on the insulation parameters, that is, on the capacitive, full and active conductivities of the electrical network phases relative to the ground, then to develop a method of determining the touch voltage, we use the mathematical dependences obtained in [1-3] for a symmetric network:

$$b = \frac{U_{ph} g_o (U_{ph} - U_{pho} Sin\alpha)}{U_{ph}^2 + U_{pho}^2 - 2U_{ph} U_{pho} Sin\alpha}. \qquad (1)$$

Equation (1) can be represented in the form, assuming that $U_l = 1{,}73 U_{ph}$:

$$b = \frac{U_l (U_l - 1{,}73 U_{pho} Sin\alpha)}{(U_l^2 + 3U_{pho}^2 - 3{,}46 U_l U_{pho} Sin\alpha) R_o}, \qquad (2)$$

where R_o – active additional resistance, which is connected between one of the phases of the network relative to the ground to create artificial asymmetry.

If any phase of the network relative to the ground is damaged, the touch voltage is determined by the formula [2]

$$U_{touch} = \beta I_o R_з, \qquad (3)$$

where $R_з$ – grounding system resistance;

β – touch voltage factor.

Solving jointly equations (2), (3) and Ohm's law, while assuming that the capacitive current is equal to the total current of the single phase-to-ground fault, we obtain a mathematical dependence of the determination of the touch voltage in a symmetric network:

$$U_{touch} = \text{b}R\frac{U_l^2(U_l - 1{,}73U_{pho}Sin\text{a})}{U_l^2 + 3U_{pho}^2 - 3{,}46U_lU_{pho}Sin\text{a}}, \quad (4)$$

$$\text{where } R = \frac{R_з}{R_o}.$$

The developed method of determining the touch voltage in a symmetrical network with an isolated neutral provides a satisfactory accuracy, since when using measuring instruments with an accuracy class of 1.0 the error does not exceed 5% and does not depend on the value of the active additional conductivity g_o that is connected between one of the phases of the electrical network and the ground.

The method of determining the touch voltage in a symmetrical network with an isolated neutral allows to ensure an increase in the level of electrical safety and reliability of the 6 kV distribution networks.

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