

USE THE METHOD GODUNOV FOR ESTIMATION OF THE TRANSISTOR'S PROCESSES IN POWER ELECTRICAL DISTRIBUTION SYSTEM

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Abstract - Article is dedicated to use the method Godunova for analysis of the transistor's processes in distributing system and their influence upon functional reliability component element and particularly breakers

Keywords: transistor's processes in power electrical systems, functional reliability of the breakers reliability protection system, electrical network.

The transistor's processes, appearing in power electrical system, have an essential influence upon functional reliability majority system element and particularly breakers and so reliable functioning the most of the system depends on functional reliability of the breakers.

When arising the transistor's processes in electric set different level voltages in power electrical systems, functional reliability of the breakers is a function of the row determined and vague factor. The appearing the transistor's processes in nodes in power electrical systems, are a function several components such as importance's unplugged current, importance's connecting restoring voltage place, where occurs the connecting process, importance's parameter appearing electric arc and velocities of their time history. In given article is considered the transistor's processes, appearing under not remote short circuits, which are considered the most heavy and which is described in [1].

The enumerated phenomena's, accompanying the transistor's processes according to [3-5] analytically can be described by following differential equations.

$$\frac{di_D}{d\tau} = d(I_m e^{-j\omega\tau}) / d\tau \quad (1)$$

$$\frac{dU_D}{d\tau} = Z_v \frac{n}{n-1} \frac{di_D}{d\tau} \quad (2)$$

$$\frac{dQ}{d\tau} = -Q_0 \left(\frac{1}{i_D} \frac{di_D}{d\tau} \cdot \frac{1}{U_D} \frac{dU_D}{d\tau} \right) = -Q \left[\frac{dU_D}{U_D} \cdot \left(\frac{dU_D}{i_D} \right)^{-1} \right] \frac{1}{d\tau} \quad (3)$$

In brought equations:

Z_v – the wave resistance of the sidebar, where exists the transistor's process.

n – the amount line, joined to bus, where is installed breaker and exists the transistor's process;

I_m – the amplitude importance of the disconnected current;

ω – the angular frequency of alternating current.

Got differential equations are nonlinear and for their decisions can be used method Godunova, which according to [4] allows to get concrete importance's a parameter, characterizing the transistor's processes and electric arcs in breaker.

The got results of the analysis and estimations of the transistor's processes and description of the electric arc in high-tension breaker of the different type, shows their high degree to accuracy and correspondence to experience to usages. This promotes the simplification to mathematical model and corresponding to descriptions of the electric arc in contrast with [1-3] parameter, characterizing the transistor's processes and electric arcs in breaker.

All this affords ground consider that use the method Godunova, promotes increasing to accuracy of the calculation parameter the transistor's processes in power electrical system and more detailed determination to functional reliability of the high-tension breakers (particularly air and vacuum) at calculation of the transistor's processes in power electrical system.

The central to development of the mathematical model of the electric arc can serve the equations to continuity, conservations of the pulse and energy and law stack of straw.

Study asymmetrical mode, which can have a different forms and length and accompanied electric arc, which can appear when unhooking different type short circuit, which accompany asymmetrical the transistor's processes in electric set different level voltages is conducted according to [5-6] with provision for her symmetrical and is classified as follows:

The equation to continuity of the electric arc has a form (4).

$$\left[\frac{\partial \rho}{\partial t} + \rho v_z \frac{\partial v_z}{\partial z} + r \rho v_z \frac{\partial v_z}{r \partial r} \right] = 0 \quad (4)$$

The equation of the conservation axial to projections of the pulse has a form (5).

$$\begin{aligned} & \left[\rho \frac{\partial v_z}{\partial t} + \rho v_z \frac{\partial v_z}{\partial z} + \rho v_r \frac{\partial v_z}{\partial r} \right] = \\ & = - \left\{ \frac{\partial \rho}{\partial z} + \frac{\partial}{r \partial r} [(\eta + \eta_r) \frac{\partial v_z}{\partial r}] \right\} \end{aligned} \quad (5)$$

At equation of the conservation to energy of the pulse have a form (6).

$$\begin{aligned} & \left[\rho \frac{\partial h_0}{\partial t} + \rho v_z \frac{\partial h_0}{\partial z} + \rho v_r \frac{\partial h_0}{\partial r} \right] = \\ & = \sigma E^2 - U + \frac{\partial}{r \partial r} [(k + k_r) \frac{\partial T}{\partial r}] \end{aligned} \quad (6)$$

If they are kept condition 4-6, that law Stack of straw can be presented in the manner of equations (7).

$$I = E \int_0^{r_1} 2\pi \sigma r dr = 2\pi E \int_0^{r_1} \sigma r dr \quad (7)$$

where: ρ - density of the ambience; V_z -axial, V_r -radial components to velocities of the ambience; p - pressure; η - viscosity of the ambience; η_T - turbulent viscosity; E -the tension; σ - conduction; U - the efficient factor of the radiation; h_0 - full entalpi; k -molecular term conduction; k_T -turbulent term conduction; r - the radius of the arc.

If equations 4-6 integrate on radius with provision for observance corresponding to limit, that presented equations 4-6 will take the necessary form:

The equation to continuity of the condition has a form of the expression (8).

$$\frac{\partial}{\partial t} \int_a^b 2\pi\rho v_z r dr + \frac{\partial}{\partial z} \int_a^b 2\pi\rho v_r r dr + q(b) - q(a) - \lambda(b) + \lambda(a) = 0 \quad (8)$$

The equation of the conservation axial аксиальной to projections of the pulse have a form (9).

$$\frac{\partial}{\partial t} \int_a^b 2\pi\rho h_0 r dr + \frac{\partial}{\partial z} \int_a^b 2\pi\rho v_r h_0 r dr - \Phi(b) + \Phi(a) + q(b)v_z(b) - q(a)v_z(a) = \frac{\partial}{\partial z} \rho\pi^2 (b^2 - a^2) - 2\pi[bS(b) - aS(a)] \quad (9)$$

Under these condition of the equation of the conservation to energy of the pulse will has a form (10).

$$\frac{\partial}{\partial t} \int_a^b 2\pi\rho v_z r dr + \frac{\partial}{\partial z} \int_a^b 2\pi\rho v_r h_0 r dr - \Psi(b) + \Psi(a) + q(b)h_0(b) - q(a)h_0(a) = \int_a^b 2\pi[\sigma E^2 - U] dr - 2\pi[W(a) - W(b)] \quad (10)$$

In brought equations are used following indications:

$q(a), q(b)$ - the flows of the mass in radial direction through borders (a) and (b) ;

λ, Φ, Ψ - functions of the change of time, $\rho; v_z; h_0$ on these border;

$S(a), S(b)$ - the functions characterizing radial flow of the pulse and energy through border $(r = b)$, which is defined by correlations (11-14):

$$S(a) = [(\eta + \eta_r) \frac{\partial v_z}{\partial r}]_{r=a} \quad (11)$$

$$S(b) = [(\eta + \eta_r) \frac{\partial v_z}{\partial r}]_{r=b} \quad (12)$$

$$W(a) = [(k + k_r) \frac{\partial T}{\partial r}]_{r=a} \quad (13)$$

$$W(b) = [(k + k_r) \frac{\partial T}{\partial r}]_{r=b} \quad (14)$$

Brought integral equations (8-10) can characterize the transistor's process, accompanied by electric arc appearing on contact of the breakers depending on velocities протекания the transistor's process and place of his (its) finding comparatively considered breaker. Using method Godunova brought nonlinear equations, with the help of which with possible linearity and in such event the transistor's process and process of the

extinguishing the electric arc in breaker different possible to consider with the help of linear equivalent equations.

CONCLUSION

Use the method Godunova for analysis of the transistor's processes the electric arc accompanied by arising on contact of the breakers allows the nonlinear curves and corresponding to differential equations, which can express the given processes linearity on determined area and go from differential-integral equations, which describe the given ned process to equivalent linear equations.

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