Method for detecting a turn-to-turn short circuit in the windings of an electric motor operating under conditions of random variations in power supply parameters and shaft loads involves measuring line voltages and phase currents, measuring the power supply frequency and the motor speed, the active component of the stator winding resistance, conducting no-load and short-circuit tests, determining the values of the elements of the equivalent circuit of a serviceable electric motor based on the obtained results, and adjusting the values of the elements of the equivalent circuit based on the results of measurements of line voltages, the power supply frequency, and the motor speed. Additionally, the steady-state regions for a three-phase power supply system are determined under the following conditions:

$M(I_a)=const$, $M(I_b)=const$, $M(I_c)=const$, $M(U_a)=const$,

$(U_b)=const$, $M(U_c)=const$, $M(f)=const$, $M(n)=const$, (1)

where $M(I_a)$, $M(I_b)$, $M(I_c)$ are the mathematical expectations of the measured effective values of the motor’s phase currents in the steady-state regions,

$M(U_a)$, (U_b), $M(U_c)$ are the mathematical expectations of the measured effective values of the phase voltages of the power supply network

$M(f)$ is the mathematical expectation of the measured effective values of the power supply frequency in the steady-state regions,

$M(n)$ is the mathematical expectation of the measured rotational speed of the electric motor shaft,

the magnitudes of the complex values of the phase currents in the specified steady-state regions are calculated using the following expression:

$$\left|\dot{I}_{rec\ a}\right| = \frac{\left|M\left(\dot{U}_{meas\ a}\right)\right|}{\left|\dot{Z}_{rec}\right|},\ \left|\dot{I}_{rec\ b}\right| = \frac{\left|M\left(\dot{U}_{meas\ b}\right)\right|}{\left|\dot{Z}_{rec}\right|},\ \left|\dot{I}_{rec\ c}\right| = \frac{\left|M\left(\dot{U}_{meas\ c}\right)\right|}{\left|\dot{Z}_{rec}\right|}, \quad (2)$$

$\left|\dot{Z}_{rec}\right|$

$$Z_{rec} = (r_1 + jx_1) + \frac{\left(\frac{r_2}{s} jx_2\right)\cdot\left(r_\mu + jx_\mu\right)}{\left(\frac{r_2}{s} jx_2\right) + \left(r_\mu + jx_\mu\right)}, \quad (3)$$

r_1, x_1 - the active and inductive resistance of the stator winding of an electric motor;

$r_2^/$, $x_2^/$ - the active and inductive dissipation resistances of the rotor winding of an electric motor, expressed in terms of the stator winding;

r_μ, x_μ - the active and inductive resistances of the motor's excitation circuit,

s - slip, which is calculated in the steady-state region using the expression:

$$S = \frac{60\cdot M(f)\cdot\frac{1}{2p} - M(n)}{60\cdot M(f)}, \quad (4)$$

where 2P is the number of pole pairs of the electric motor.

The calculated modulus values of the complex phase currents are compared with the mathematical expectations of the measured effective values of the phase currents in the steady-state region, and the difference between them is used to determine the initial moment of the occurrence of a turn-to-turn short circuit in the stator winding of the electric motor.