Yuriy E. Obzherin, Stanislav M. Sidorov (Sevastopol State University) **Semi-Markov model of a system with element-by-element time reserve.**

The work [1] presents a semi-Markov model (SMM) of a multicomponent system with a group slack time. In this work, we build a SMM of a multi-component system with an element-by-element time reserve, and determine the stationary characteristics of reliability and efficiency.

Theorem. Stationary distribution of an embedded Markov chain $\{\xi_n; n \geq 0\}$ the system under consideration has the following form:

$$\rho\left(i\bar{d}\bar{x}\right) = \rho_0 \prod_{k=1}^{N} \rho_{d_k}^{(k)} \prod_{j=1, j\neq i}^{N} \overline{V}_{d_i}^{(j)}\left(x_j\right), \tag{1}$$

where the constant ρ_0 is found from the normalization condition, $V_z^{(k)}(t) = P\left(\delta_z^{(k)} < t\right)$ – probability distribution functions of random variables $\delta_z^{(k)}$, $\overline{V}_z^{(k)}(t) = 1 - V_z^{(k)}(t)$,

$$\delta_z^{(k)} = \begin{cases} \alpha_k, & \text{if } z = 1, \\ \beta_k \wedge \tau_k, & \text{if } z = \overline{1}, \\ \left[\beta_k - \tau_k\right]^+, & \text{if } z = 0, \end{cases} \quad P\left(\left[\beta_k - \tau_k\right]^+ \leq t\right) = 1 - \frac{\int_0^\infty \overline{G}_k\left(y + t\right) r_k\left(y\right) dy}{P\left(\beta_k > \tau_k\right)},$$

$$\rho_z^{(k)} = \begin{cases} \rho^{(k)}, & \text{if } z = 1, \overline{1}, \\ \overline{\rho}^{(k)}, & \text{if } z = 0, \end{cases} \quad \rho^{(k)} = \frac{1}{2 + P\left(\beta_k > \tau_k\right)}, \quad \overline{\rho}^{(k)} = \frac{P\left(\beta_k > \tau_k\right)}{2 + P\left(\beta_k > \tau_k\right)}.$$

The d_k component of the vector $\bar{d}$ describes the physical state of the component with number k:

$$d_k = \begin{cases} 1, & \text{if the } k\text{th element is operational,} \\ \overline{1}, & \text{if the } k\text{th element is restored and operates due to the time reserve,} \\ 0, & \text{if the } k\text{th element is in failure.} \end{cases}$$

The continuous component x_k of the vector $\bar{x}_k$ indicates the time that has passed since the last change in the physical state in the component with number k, $x_i = 0$.

[1]. Obzherin Y.E., Sidorov S.M. Semi-Markov model and phase-merging scheme of a multi-component system with the group instantly replenished time reserve. International Journal of Reliability, Quality and Safety Engineering. 2019. Vol. 26. No 3. Art. no. 1950014.