TECHNIQUE OF FORMATION HOMOGENEOUS SAMPLE SAME OBJECTS

Muradaliyev A.Z.

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Azerbaijan Scientific-Research and Design-Prospecting Institute
of Energetic AZ1012, Ave. H.Zardabi-94
E-mail:aydin_murad@yahoo.com

Importance of a problem. Reliability of electro power systems (EPS) in many respects depends on reliability of the capital equipment and devices (objects EPS). Modern objects EPS concern to a category of complex objects (CO). CO - multivariate, in other words, characterized greater number of attributes and their versions. As first approximation, these attributes presented by two groups. The first group of attributes characterizes a design CO and the second presented in characteristics sheet, and the second group -conditions of operation CO.

If necessary estimations of a technical condition CO (for example, at an estimation of expediency of a conclusion CO on major overhaul), data on a technical condition of it CO, as a rule, it appears insufficient. Insufficient there are not only data on emergency and scheduled switching-off, but also data on size of deterioration and speed of its change. For this reason normative materials attraction of retrospective data about reliability same CO [1] recommended. At this classification influence, the second group of attributes that increases risk of the erroneous decision is not considered.

Classification CO represents not only important, but also a difficult problem. Its difficulty caused by necessity of research of homogeneous (unpresentable) sample CO from a final data set (FDS).

According to GOST 15895-77 «Statistical methods of product quality control» representative sample is sample (test), which sufficiently reflects properties of the given set (in our case FDS) as a whole. But what such "sufficiently"?

Let's enter some definitions of terms:

- under unpresentable we shall understand sample on a number of versions of attributes (VA), statistical function of distribution (s.f.d.) which not casually differs from s.f.d. FDS [2].
- under FDS we shall understand the retrospective information presented in the form of the empirical table (ET).
- under ET we shall understand the table which lines contain the information on conditions (results of test) CO, and columns - versions of each of examined attributes [3].

In the illustrative purposes as CO examine power transformers and autotransformers (further: transformers (TR)). On table 1 are resulted passport data TR, and in table 2 - conditions of operation TR in AISTR [3]. These data examined as attributes TR.

Tables 1 and 2 testify that alongside with quantitative estimations VA, there are also quality standards. For example, a factory manufacturer TR, system of cooling, a consequence of refusal, etc. Thus, attributes CO have various scales of measurement

Table 1

NAMEPLATE DATA THE TRANSFORMER	
Name of the enterprise * **NNN**	
Name of substation * **MMM**	
Dispatching designation **AT1**	
Type the transformer * **ATDCTN-200000/220**	
Kind the transformer * **autotransformer**	
Factory-manufacturer * **ZTZ**	Factory number
Year of manufacturing **1984**	
Rated voltage, кv **330**	Rated power, Mva **133**
Number of phases **1**	Phases * **A**
Number of windings **3**	
Type of a RE * **RNOA-220/1250**	Drive of a RE * **PDP-4U1**
Type a winding of LP *	
System of cooling * **DC**	
Way protection of butter * **film**	
Execution butter filled inputs *	

Table 2

PASSPORT CONDITIONS OF OPERATION THE TRANSFORMER	
Purpose of the transformer * **Connections SC**	
Name of the enterprise * **NNN**	
Name of substation * **MMM**	
Dispatching designation **AT1**	
Type the transformer * **ATDCTN-200000/220**	
Year of manufacturing **1984**	
Year of commissioning **1985**	Year of dismantle
Condition a neutral * **neutral is earthed**	
Condition of a RE * **Working**	
Loading of a winding of LP * **synchronous equalizer**	
Maximal loading, r.u. **0.77**	Number of c.s.c. **3**
Consequence of refusal * **Decrease in structural reliability**	
Results of test:	
CADG - **Condition of risk**	Inputs - **Admissible**
PCAB - **Admissible**	RE - **Condition of risk**
Active part - **Admissible**	System of cooling - **Admissible**
Area of storm protection **1**	Date of last MO **14.02.2003**

Formally, at classification of retrospective data on set VA, the information on technical condition TR sharply decreases, and in a greater part of cases does not allow have not only quantitative, but also quality standard of parameters of reliability TR. At the same time it is clear, what not all attributes TR are equally significant (from the point of view of reliability of work), and a functional divergence s.f.d. FDS and samples should be not less guaranteed value of its statistical component.

Recommend method. Assume that:

- nameplate data and data on conditions of operation of all TR power supply systems, and on dispatching magazines and certificates of failures data on scheduled and emergency switching-off TR are received. On these data two are made ET, first of which (ET1) the second includes data on design features and conditions of operation TR, and (ET2) - data on switching-off TR and minimally necessary data for an input in ET1;

- is known deduced on major overhaul TR for which it is necessary to find homogeneous sample of the same objects.

Let's designate number examined TR through M_{TP}, number of attributes- n_{np}, number VA i-th TR - r_i with $i = 1, n_{np}$.

Following calculations are spent:

1. For each of M_{TP} TR the interval of time during which the characteristic of emergency and scheduled switching-off TR known is determined. Designate this interval through $\Delta\tau_i$ with $i = 1, M_{TP}$.
2. In each of $\Delta\tau_i$ an interval, it is determined total duration of scheduled switching-off (switching-off on CR, operating repair, in a reserve, etc.). Designate this size as $\Delta\tau_{i,\Sigma}^{П}$;
3. Determine size $\Delta\tau_{\Sigma} = \sum_{i=1}^{M_{TP}} \Delta\tau_i - \sum_{i=1}^{M_{TP}} \Delta\tau_{i,\Sigma}^{П}$ - total duration of work and idle time in emergency repair.
4. Determined total number of emergency switching-off TR. Considering, that emergency switching-off happen automatic, manually and under the emergency application, and consequences of switching-off TR under the emergency application, as a rule, it is essential less consequences of first two kinds of switching-off, expedient to spend separate classification of switching-off. Designate number of examined emergency switching-off (for example, under the emergency application) through $n_{\Sigma}^{ав}$;
5. Calculate an estimation of specific number of emergency switching-off TR: $\lambda_{TP}^{*} = n_{\Sigma}^{ав} / \Delta\tau_{\Sigma}$.

In a basis of estimation, λ_{TP}^{*} there is assumption of constant probability occurrence emergency switching-off during an individual interval of time (year). Operating experience shows, that non-failure operation TR depends both on their design, and from conditions of operation. Therefore, the average value of size λ_{TP}^{*} has no practical sense. Concrete TR can have in park TR analogues, in the form of same TR. However, this sample is non-uniform, since TR can differ with conditions of operation (for example, service life). Therefore, recommendation [1] about expediency of the account of data on a technical condition of the same objects demands the specification. If to agree with the above-stated, it is possible to make following next steps:

6. For everyone VA set TR the specific number of emergency switching-off $\lambda_{TP,j}^{*}$ with $j = 1, n_{np}$ is calculated. The purpose of these calculations is the finding

$$\lambda_{TP,max}^{*} = max\left(\lambda_{TP,1}^{*}; \lambda_{TP,2}^{*}; \lambda_{TP,3}^{*}; \quad ; \lambda_{TP,j}^{*}; \quad \lambda_{TP,n_{np}}^{*}\right);$$

7. Estimations λ_{TP}^{*} are compared and $\lambda_{TP,max}^{*}$. Comparison spent in view of casual character of these estimations, and in view of not only errors of the first, but also the second sort. The methodology of this comparison is based on the theory of statistical modeling and the theory of check statistical hypotheses and stated by us in [5]. If it appears, that the hypothesis about a casual divergence λ_{TP}^{*} and $\lambda_{TP,max}^{*}$ is more preferable (less sum errors of the first and second sort), than an alternative hypothesis, having in view of, that a casual divergence λ_{TP}^{*} and $\lambda_{TP,max}^{*}$ simultaneously means a casual divergence λ_{TP}^{*} and $\lambda_{TP,j}^{*}$ with $j = 1, n_{np}$ within the limits of had statistical data about emergency switching-off TR any of VA insignificant and all TR is represented with a file of homogeneous same objects, specific which number of refusals equally λ_{Σ}^{*}. Though at classification of retrospective data only to one attribute it is improbable, the statement at a casual divergence λ_{TP}^{*} and $\lambda_{TP,max}^{*}$ remain constant for any number VA. Moreover, process of search of homogeneous

sample same TR stops, and management is (if necessary) transferred to a press of their list.

8. If the hypothesis about not casual distinction λ^*_{TP} and $\lambda^*_{TP,max}$, sample TR for which the specific quantity of emergency switching-off equally $\lambda^*_{TP,max}$ is accepted for FDS and on these statistical data is more preferable:

9. Estimations $\lambda^*_{TP,j}$ are calculated with $j = 1,(n_{np} - 1)$;

10. Determined $\lambda^*_{TP,max} = max\{\lambda^*_{TP,j}\}_{(n_{np}\ 1)}$;

11. Estimations λ^*_{TP} and $\lambda^*_{TP,max}$ (see item 7) are compared;

12. See item 8. Recurrence of cycles of classification of data and checks of hypotheses is carried out up to an opportunity of the proved acceptance of a hypothesis about a casual divergence of estimations λ^*_{TP} and $\lambda^*_{TP,max}$. The integrated block diagram of algorithm of formation of homogeneous sample same TR is resulted on fig.1.

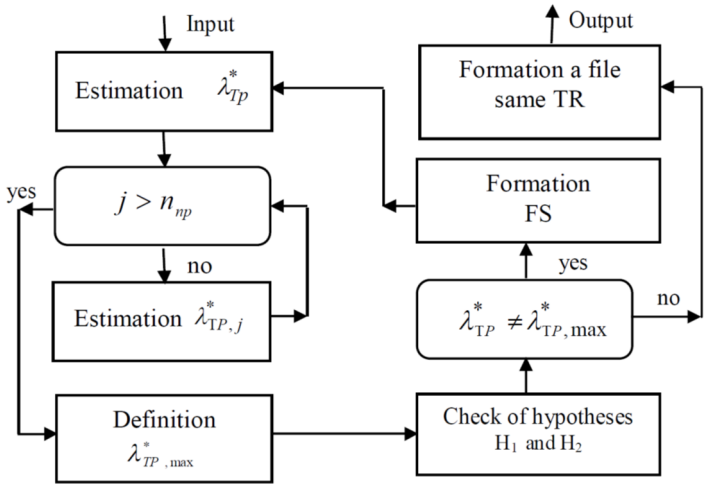

Fig.1. Integrated block diagram of algorithm of formation of homogeneous sample of the same objects

CONCLUSION

1. Control of a technical condition concrete TR retrospective data about reliability same TR not always can far appear useful. It concerns, first, to TR with the service life exceeding normative value, working unlike controllable TR in conditions with the intensive storm activity, through currents of short circuit exposed to frequent dynamic influence, etc.
2. Method and algorithm of formation of homogeneous sample same TR is developed.
3. Practical realization of algorithm and the program of formation of homogeneous sample same TR allows to specify list TR, the information on which technical condition promotes recognition of a technical condition controllable TR and by that to raise objectivity of recommendations on increase of reliability TR.

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