FACTORS OF REFUSALS IN ELECTRICAL DISTRIBUTION NETWORKS 10 KV

POPESCU V.
State Agrarian University of Moldova

Abstract – At present, in electrical distribution networks with tension 10 kV take place a significant number of refusals, which affect the reliability of electricity supply to all consumers. The behavior of these interruptions permit the development of the mechanism for ensuring continuity of electricity supply to consumers.

Ensurance of continuity of quality power supply of consumer can be achieved only on the bases of profound knowledge of the phenomena that accompany this process, which permits a justified planning from technical and economic point of view, measures and activities of exploitation services of electrical distribution networks with tension 10 kV, in view to ensure the normal indicators of reliability.

The paper is devoted to assessing the distributions of refusals in electrical networks with tension 10 kV, for developing the forecasting mechanism and to ensure the reliability of power supply.

Key-words - reliability of electrical networks 10 kV, reliability indicators, factors of influencing, the distribution of refusals.

1. INTRODUCTION

Currently electrical distribution networks with tension 10 kV have a very high degree of complexity due to increasing number of energy consumers and of load nodes. Providing consumers with quality electricity is a serious and acute problem also because of rejections and disconnections of equipment installed in distribution networks with tension 10 kV. The large number of rejections and disruptions significantly affect energy consumers. Identifying the cause of these interruptions and determination of their behavior and of the level of influence on the reliability of the equipment installed in distribution networks with tension 10 kV, allows the developing of measures to ensure continuity of supply to consumers [2-5].

The characteristics of refusals, their distributions over time, the causes of appearance and of their impact on the reliability of electricity supply to consumers are currently not studied at the stipulated level by documents into force on continuity and quality indicators. The reliability of electricity supply to consumers can be assured only on the basis of profound knowledge of the factors that influence directly, and allow technically and economically, planning justified measures to ensure the standardized indicators of reliability.

Article is devoted to assessing the distributions of refusals in the process of electricity distribution,for forecasting and to ensure the reliability of power supply.

2. MATERIALS AND METHODS

In this paper, the research object is the refusals of electrical distribution networks, caused by various random factors of influence. Were investigated 5 distribution systems, with summary networks length of systems - 14240 km, the number of consumers supplied – 874535, the number of examined interruptions – 72294 and the research period 2011-2014.

To solve the problems raised in the paper were used the following means:

- diacoptica;
- graph theory and matrix; probability theory;
- methods of prosesing and analysis of experimental data;
- theory of linear and nonlinear equations;
- mathematical modeling.

To perform the forecast of intensity of electrical distribution networks refusals were analyzed various factors of influence, which generated the random interruptions.

The algorithm for carrying out investigations comprises the steps [1,3]:

- Registration of experimental data regarding disconnections of electrical distribution networks;
- Processing of breaks according to their character of appearance and the factors of influence;
- Assessment of theoretical laws and parameters characterizing the distributions of refusals;

3. RESULTS AND DISCUSSION

Using the criteria proposed for processing of experimental data on refusals in the examined networks, allowed the determination of frequencies of refusals caused by each random factor of influence. Based on the concept of general methodological approach on forecasting indicators that characterize the quality of operation of the equipment of electrical networks (transformers, disconnectors, etc.) were established the laws of occurrence of refusals, which allow to predict the behavior of factors influencing reliability of electrical networks.

Under this standard process the parameters of distributions of random disconnections caused by factors of influence were determined for the period of study. Table 1 shows the values of determined parameters, for example, for medium voltage networks (average number of interruptions per year, dispersion D, square standard deviation σ, coefficient of variation, minimum and maximum number of interruptions per year, the tuning fork , the marginal values of confidence intervals, coefficients of asymmetry and excess, type of distributions).

Table 1. Parameters of annual distributions of refusals caused by the most influential factors

Year	Parameters of the distributions disconnections								
	Average number of inter.	Min. number of inter.	Max. number of inter.	The tunning fork	The lower marginal	The upper marginal	Coef. of asymmetry	Coef. of excess	Theoretical distribution close
Weather conditions	65,18	55,20	74,17	18,97	58,55	71,80	-0,23	-0,15	Gauss
Defects in equipmen	54,83	44,53	68,22	23,69	48,20	61,45	0,50	-0,75	Gauss
Wildlife action	68,09	51,95	91,00	39,05	61,46	74,71	0,63	-0,13	Gauss
Flora action	56,59	48,03	60,65	12,61	49,97	63,22	-0,72	0,77	Gauss
Total	63,61	44,53	91,00	46,47	57,62	69,59	0,66	-0,31	Gauss

Examining the values of the parameters set it can be concluded that the nearest theoretical distribution of these events is the Gaussian distribution and the data we have allow us to estimate the marginal values of the expected deviations of the arithmetic mean in all the analyzed data, i.e. values limits of random interruptions specific for every year. The expected value of the arithmetic average of random disconnections for the power grid the length of which is 100 km is within $57.62 < Ndec. < 69.59$.

Using the processing of experimental data and the concept developed for processing of interruptions, the frequency of appearance of refusals due to each random factor, for 100 km of line, for each system depending on the season was determined. All this has made it possible to simplify the calculation and determine the distribution of interruptions for all random factors of influence, depending on frequency of appearance per system and season, for determining the complex structures and to frame measures to increase the reliability of distribution systems.

The values obtained indicate that in the republican networks the average intensity of random disconnections during the year exceed the amount of 57.62 disconnections per year per 100 km of network, but their number will not exceed an annual average of 69.59 random disconnects per 100 km of network. This forecast error is of about 5 %.

It was established that to prognosticate the behavior of random factors on the reliability of electricity distribution networks, it is imperative to determine the distribution laws of refusals caused by respective factors and parameters of these distributions. In accordance with the observed the experimental distributions and theoretical were considered for the following indicators: frequency of refusals on the system and season, length of refusals and number of consumers disconnected.

Given the fact that the distribution of these disconnection is close to the Normal and by experimental knowledge of the mean square deviation $\sigma = 11.61$, we can estimate the marginal values of the predicted number of random disconnections and of their parameters for electrical networks with different length. This is possible because we have shown that ensembles of data, which include the total number of random disconnection during the years 2011-2014 in different branches of the network belong to the same community of experimental data.

The proposed criterion permits that in dependace of lines length to forecast the number of random disconnections during each year. Statistical credibility of the forecast on marginal limits of variation of the number of predicted disconnections is 95 % and the forecast error does not exceed 5%.

On this concept the laws of distribution can be determined, and the parameters reported in the 100 km of network for all influencing factors. Parameters obtained will be used to forecast the intensity of reliability indicaters, based on the individual characteristics of each network.

These parameters determine the level of confidence in the functioning of the equipment installed in the electric distribution networks, the obtained results regarding their forecasting, permit justified planning of technical and economic activities to ensure the continuity and quality of electricity supply to consumers taking account of according to normal indices of reliability.

CONCLUSIONS

The proceeding of a extensive set of experimental data on denials of electrical distribution networks, allowed to evidence the parameters and to determine the distributions of refusals in electrical network systems using motivated and veridicalcriteria.

We established the experimental and theoretical distributions that describe the intensity of occurrence of refusals and the results permit justified planning of technical and economic activities to ensure the continuity and quality of electricity supply to consumers taking account of according to normal indices of reliability.

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ABOUT AUTHOR

Popescu Victor, Moldova State Agrarian University, Doctor of engineering, associate Professor, Chair of "Electrification and Automation". Scientific activity - Electrification and automation, Reliability of electrical systems. Email: vspopescu @ uasm.md, vspopescu @ mail. ru