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# Electricity Quality And Power Consumption In Low Power (0.4 Kv) Networks

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## ABSTRACT

Research is being conducted in Uzbekistan on the cases of symmetrical operation of low-voltage (0.4 kV) power distribution networks. One of the main reasons for the excess of electricity quality indicators over normative indicators is the uneven distribution of network phases, which leads to an increase in energy losses.

## KEYWORDS

Electricity, wastes, power quality, measuring devices, voltage asymmetry, power grid, research, additional power losses.

## INTRODUCTION

The study of symmetrical operating conditions of low-voltage (0.4 kV) power grids is carried out in three stages: measurement, calculation and analysis of the data obtained; practical recommendations; the state of operation of the network is normalized by means of technical means. Measurements were made with an approved Malika-01 device. According to the results of the study and analysis of the relationship between voltage symmetry and additional power losses in existing 0.4 kV networks, it was found that the quality of electricity in the studied networks does not meet the requirements of state standards and voltage symmetry indicators exceed GOST.

One of the main reasons for the excess of electricity quality indicators over the set value is the unbalanced loading of power grids, which leads to an increase in electricity losses. The study of unbalanced operation of 0.4 kV transmission lines was carried out in three stages: measurement, calculation and analysis of the received data, development of practical manuals and proposal of technical means for normalization of network operation. Measurements were made using a certified Malika-01 device. The results of the study and the analysis of the relationship between the obtained voltage equilibrium indices and additional losses in 0.4 kV networks revealed that the quality of electricity in the tested networks does not meet the requirements of the State Standard and voltage balance indices exceed GOST (State Standard).

One of the important criteria for assessing the quality of electricity is the indicators that characterize the symmetry of the three-phase voltage system. There are short-term (emergency) and long-term (operational) symmetrical cases in power supply systems. Short-term unbalanced conditions are usually associated with various emergency processes, such as unbalanced short circuits, phase ground faults, breakage of one or two wires, and so on. Long unbalanced situations are usually caused by connecting elements of the power grid to non-phase rods (single, two-phase branches) or symmetrical (single, two or three-phase) loads to the power supply system. The symmetry of the currents that occur for various reasons flows through the elements of the electrical network, causing a symmetrical voltage drop across them, which in turn leads to the symmetry of the voltage system.

Criteria for assessing voltage symmetry are determined by two qualitative indicators: that is, the coefficients of voltage symmetry in the inverse and zero sequences, the values of which are regulated by GOST. In addition, the symmetrical parts of the reverse and zero-sequence currents passing through the elements of the electric network result in significant additional active losses of electrical energy.

## THE MAIN PART

Many scientists around the world have studied the symmetry of currents and voltages, evaluated their effects, and developed methods and special techniques to minimize these effects. No such studies have been conducted in Uzbekistan. The purpose of the study was to analyze the quality and additional losses of electricity in 0.4 kV transmission lines (TP-503,504 and 518) in Andijan region.

To achieve this goal, the following tasks were set:

1) Use of ASKUE data to determine the average value of current and voltage in power transmission lines at different times of the year (hot, cold, foggy and humid);
2) Calculation of electricity quality indicators, as well as additional losses of active power using the developed model;
3) To compile and analyze the time schedule of the studied quantities, to determine the nature of their measurements;
4) Economic assessment of power losses of low-voltage assets;
5) Suggest ways or techniques to normalize quality and reduce energy losses.

I would like to show the results of the research conducted at TP-503, 504 and 518 of the Bobur ETC of Andijan region, the specifics of the substation and the connected consumers are shown below.

The substation is equipped with a TM-630 10 / 0.4 kV voltage transformer.

There are 4 power transmission lines (power transmission lines) made of SIP-2 cable. The total length of the transmission line is 949 m, of which corresponds to the 1st transmission line produced by SIP-2, size 50 mm2, - 321 m; Made of 2-SIP-2 wire, 35 mm2 power transmission line -214 m; Made of SIP-2 wire, size 16 mm2, - 414 m., The number of consumers, connected to the phase voltage, which creates a three-phase symmetrical load, is distributed as follows: Phase "A" - 95 pcs .; "V" phase - 95 pieces; phase "S" - 93 pcs. Homes with an electrical receiver load are a household consumer.

For example: electric heaters (in winter), electric ovens, refrigerators, washing machines, irons, lighting fixtures, televisions, hand-held electrical appliances, etc.

The total installed capacity of consumers is 5 kW (for each family). An approved Malika-01 instrument was used as the measuring instrument, the connection of which is shown in Figure 1.

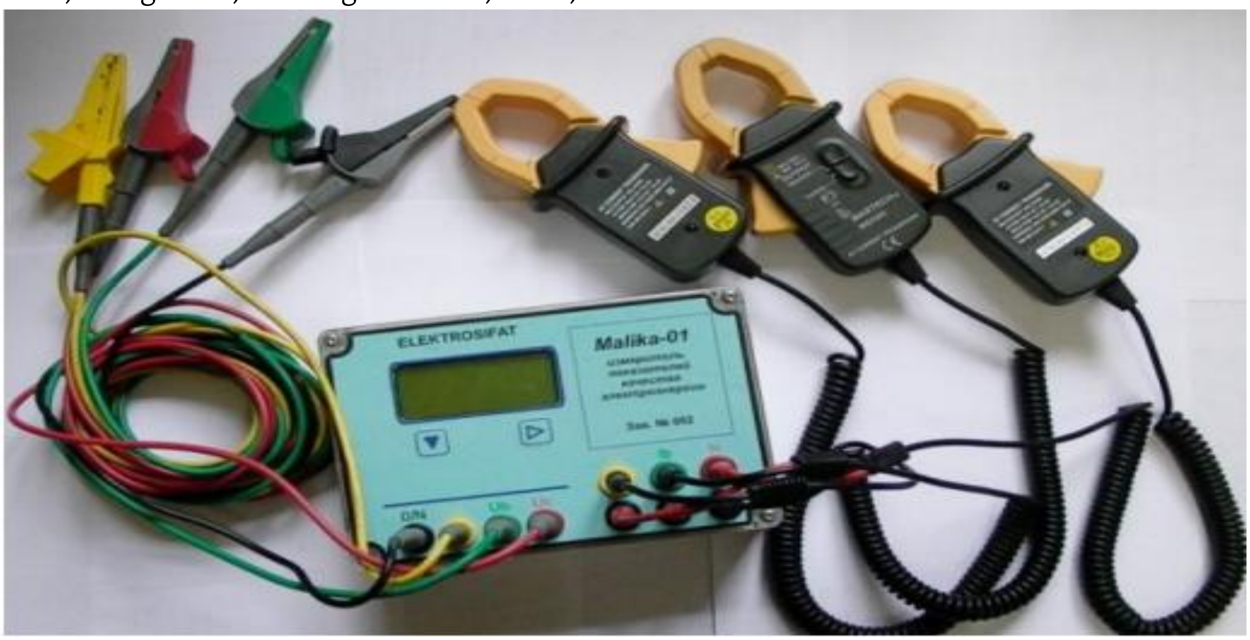



Figure 1. Princess-01 device.

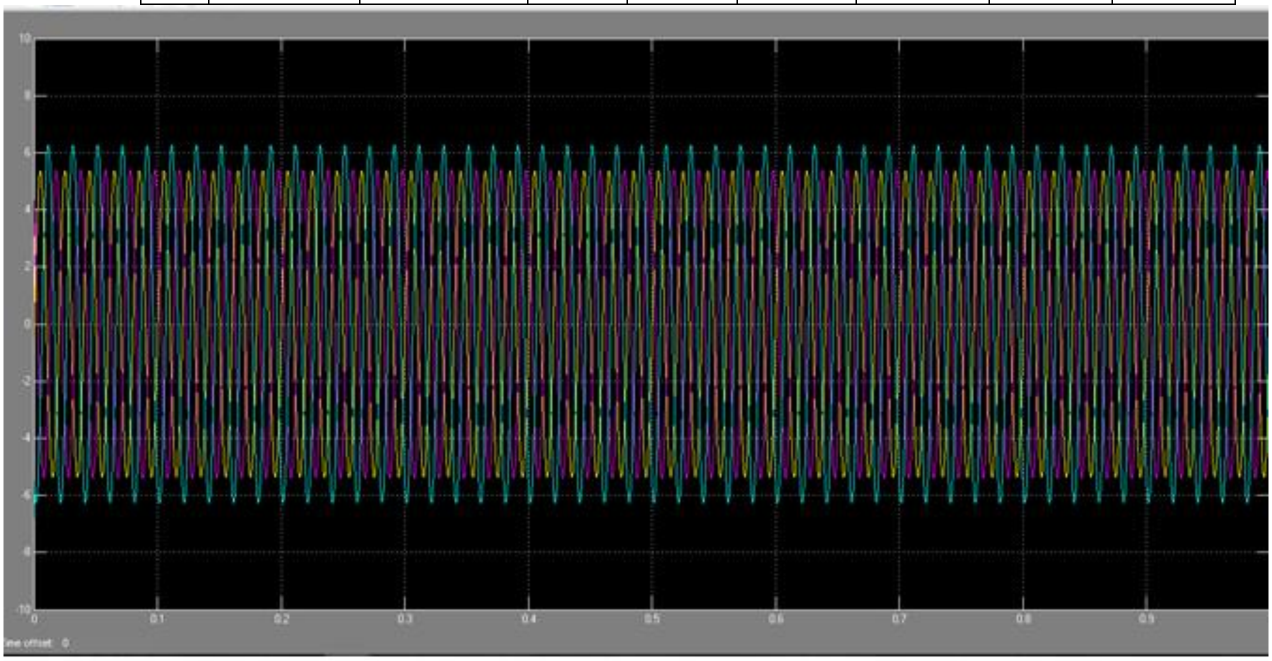
Based on data obtained through the device "Princess-01".

The results of the measurements obtained using the symmetry program were tabulated.

Based on the table data, time schedules of current changes are compiled, as well as power quality indicators and additional losses. Figure 3 shows a time diagram of the phase currents in the power transmission lines being tested. The most loaded phase is “C”, through which the average current for the time flow period studied is 35.4 A, while in phases “A” and “B” such current is 12.8 and 9.3 A, respectively. Such a “phase disproportion” has led to the emergence of current asymmetry coefficients along the inverse (K2U) and zero (K0U) sequences. Their mean readings over the study period were 0.47 and 0.45, respectively, which led to an increase in power losses characterized by an additional loss coefficient of KP, averaging 2.4 (Figure 4).

Results of the study of symmetric cases in TP 503

| № | Tittle | Power | Ua | Ub | Uc | Ia | Ib | Ic |
|---|---|---|---|---|---|---|---|---|
| 1 | TP-518 | 630 кVA | 217 | 219 | 254 | 55,17 | 49,21 | 41,07 |
| 2 | TP -504 | 400 кVA | | | | | | |
| 3 | TP -503 | 250 кVA | | | | | | |



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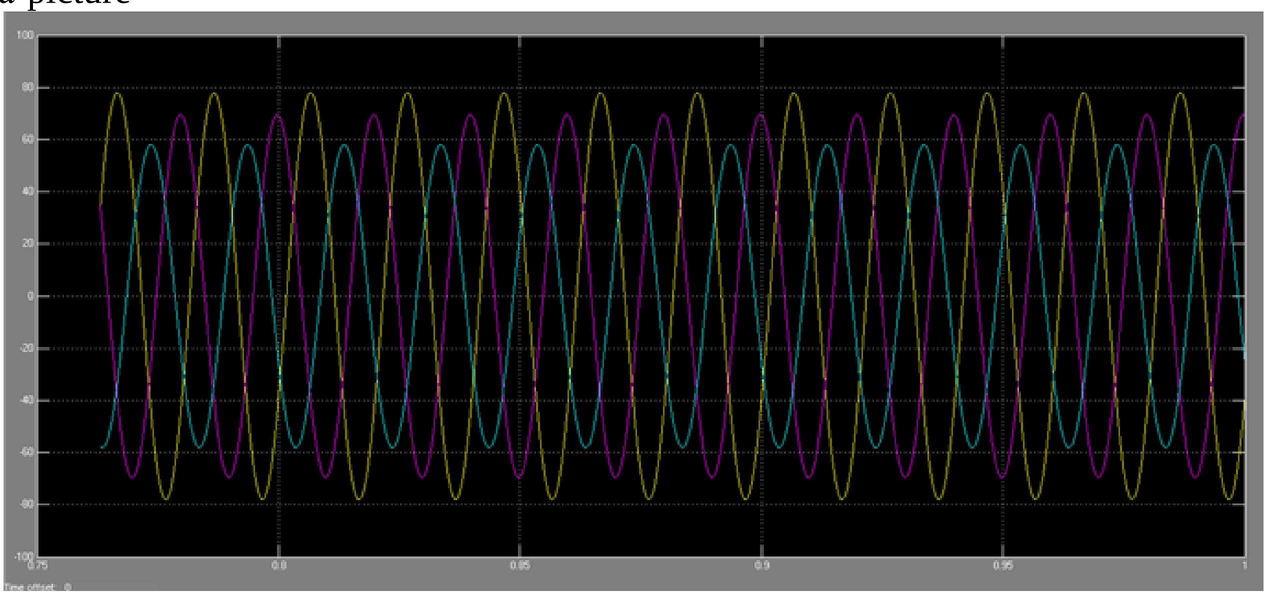

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Figure 2. Time change tables of currents (a) and their symmetry indicators - coefficients (b) in reverse and zero sequence

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Thus, in a true asymmetric state, the loss of electrical energy is 2.4 times higher than the loss due to direct current flows alone. Consider how additional power losses in a symmetrical case affect the increase in electricity prices. We anticipate that electricity will be transmitted continuously throughout this year through this transmission line. Thus, the loss time can be conditionally taken to be 2190 hours (91 days) (for each season of the year).

Then the complete loss of electricity in the power transmission lines being tested, taking into account the symmetry

Currents in each phase:

$\Delta W = \ell * r0 * t * (I\_A^2 + I\_B^2 + I\_C^2)$ (1)

where $\ell$ is the length of the power transmission lines being tested (0.989 km);

r0 is the active resistance of 1 km of wire, equal to 0.641 Ohm / km;

IA, IB, IC are the average values of the phase currents in the power transmission lines for the period under study, respectively (average phase currents in the measurement period are 12.76; 9.3 and 35.4 A, respectively).

Thus:

$\Delta W = 0.989 * 0.633 * 2190 * (12.762 + 9.32 + 35.42) = 1575.55$ kVt * s

In the conditionally symmetrical state, the power loss (in this case) is the power loss coefficient 1), the average value of the loss coefficient is 2.43:

$\Delta Wsim = \Delta w / K\_r = 1575.55 / 2.43 = 648.37$ kW * s

Loss of electrical energy due to asymmetry of phase currents:

$\Delta Wnos = \Delta W - \Delta Wsim = 1575.55 - 648.37 = 927.18$ kW * s

The cost of electricity for consumers is 390 soums / kWh. As of August 20, 2020, in dollar terms, it is $ 0.038 / kWh ($ 1 = 10,320 soums).

Thus, the value of additional power losses due to asymmetry of currents in the power transmission line under test for one year is as follows: It should be noted that these power losses and their value are calculated directly for the power transmission line under study. The currents of the zero and reverse series across the low voltage circuit of the power transformer lead to an increase in losses, which is determined by the sum of the currents of the reverse and zero series of each.

Thus, at 100% of the measurement time, the coefficients K2U and K0U are calculated in advance, the values are 2.34 and 2.7 times, respectively, and 95%, respectively, in the study period, these values exceed the normal (2%) values, respectively, of course 4.65 and 5.4 once.

The decrease in the symmetry of the operating state of this power grid may be due to the systematic (random) and probable asymmetry of the phase currents [6].

Due to the unevenness of the composition, the statistical symmetry of the currents is reduced by the redistribution of single-phase loads, which can be single-phase load distribution in the phases of a three-phase power grid, ie: remove the load overloaded "C" phase - 16.5 A and "A" - 6, 2 to phase A and phase "B" -9.6 A

However, the probability component of the symmetry of the currents cannot be reduced by anything other than a balancing device. As a result, the most effective means of normalizing the operating condition of this transmission line is to connect a shunt balancing device, the parameters of which can be calculated according to the method shown in [7] :( 2).

where is the complex conductivity of the forward, reverse, and zero sequences of the equilibrium device, respectively;

- The corresponding conductivity of the equivalent chains, direct, inverse and zero sequences;
- Complex conductivity of the electric network, direct, reverse and zero sequences, respectively;
- Forward and reverse conduction of a three-phase symmetrical load, respectively.

Only because the utility is connected to this power grid loading, so this permeability can be neglected. Using this technique, it was possible to determine the parameters of the balancing device of the power transmission line under study:(3)

It should be noted that the study of symmetrical operating conditions is only for one power transmission line for the specified TP-518 and only for one winter condition. In addition, additional losses in the power transformer were not taken into account. In fact, the pictures of the TP-518 and the four output power lines located on the transformer itself are as follows. The total value of additional power losses due to phase asymmetry

Currents in four output lines and TP-518 power transformer: in winter:

1403921 soums. = $ 758.12; in the spring: 914030 soums. = $ 494 $; in summer: 851051.25 soums. ($ 443);

in the fall: 842669 soums, ie. The total annual losses in this sector amounted to 3972522.2 soums. ($ 2,066).

## CONCLUSION

Thus, the analysis showed that the operating mode of the tested power grid is symmetrical, in particular, it requires the installation of a symmetrical device in order to reduce additional losses and improve the quality of electricity.

## REFERENCES


1. Evaluation of Power Losses under Asymmetrical and Nonsinusoidal Modes I.KH. KHOLIDDINOV, M. YULCHIEV, KH.A. ERALIEV, M.M. KHOLIDDINOVA // INTERNATIONAL JOURNALOF ADVANCED RESEARCHIN SCIENCE, ENGINEERING AND TECHNOLOGY // VOLUME 7, ISSUE 7, JULY 2020
2. Patent UZ FAP №01166. Ustroystvo dlya registratsii dopolnitelnyx poter elektroenergii pri nesimmetrii nagruzok v nizkovoltnyx elektricheskix setyax./ Allaev K.R., Shaismatov S.E., Kholiddinov I.X.// Rasmiy informatnoma. – 2016, - № 12. - S. 36. 22.05.2015.
3. Kosouxov F.D. Methods of calculation and analysis of indicators of asymmetry of currents and pressure in rural distribution networks: uchebnoe posobie. - L .: LSXI, 1984. - 42 p.
4. Kosouxov F.D., Naumov I.V. Nesymmetry napryajeniy i tokov v selskix raspredelitelnyx setyax. - Irkutsk, 2003. —260 p.
5. Naumov I.V., Pod'yachix S.V., Ivanov D.A., Shpak D.A. Issledovanie i analiz dopolnitelnyx poter moshchnosti i kachestva elektricheskoy energii v selskix raspredelitelnyx setyax napryajeniem 0,38 kV pri nesimmetrichnoy nagruzke // Otchët o vыpolnenii NIR i prakticheskie rekomendatsii.— Irkutsk.1r.
6. Naumov I.V. Optimization of asymmetric conditions of the system of rural power supply. - Irkutsk: Na Chexova, 2001. —217 p.
7. Naumov I.V., Ivanov D.A., Gantulga D.Automatic control of the balanced devices indistributing networks 0.38 kV // “Engineering Problems in Agriculture and Industry”. - June 2-4, 2010, Ulaanbaatar, Mongolia. - P. 105-108.

**Published:** September 30, 2020 | **Pages:** 159-165
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**8.** Naumov I.V., Prutkina A.V. Selection of parameters of symmetry ustroystva in dependence on izmenyayushchixsya pokazateley nesimmetrii in raspredelitelnyx setyax