The use of an automated information system for monitoring and metering electricity in resolving disputes between economic entities

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Abstract. The results of the study of the quality of electrical energy using an automated system with radio data exchange channels are considered. The parameters of the quality of electrical energy recorded by multifunctional metering devices showed that, on average, up to fifteen percent of the energy supplied during the year does not meet the regulatory requirements and conditions for ensuring the supply of electrical energy under an energy supply agreement at the facilities under study. The consumer intends to use the obtained instrument data when drawing up a statement of claim to the court to reduce the payment for the supply of low-quality electricity.

1. Introduction

With the development of technologies, the requirements for the quality of electrical energy are increasing, complete information about which cannot be obtained without modern multifunctional measuring devices. The quality of electricity, measured at the point of its transmission to the user, in general-purpose power supply systems is standardized by GOST 32144-2013. Control and metering devices record, store and transmit the parameters of electric current to interested organizations.

When carrying out a set of measures for the creation of an automated information system for monitoring and metering of electrical energy (AISKUE), experts checked the compliance of the quality parameters of electricity supplied to the facilities of EuroSibOil LLC by the guaranteeing supplier of electrical energy, Joint Stock Company Kalmenergosbyt, within a year, with regulatory requirements and supply conditions electricity under an energy supply agreement. Also, on the basis of the current regulatory documents, the amount of reduction in payments for low-quality electricity supplied to the facilities of EuroSibOil was calculated.

2. Materials and methods

Oil production associated with other systems refers to production with a continuous technological cycle. The stoppage of its production can lead to disruption of the entire production and technological chain, where pumps of various types are used: sucker rod and screw, electric centrifugal, etc. It is difficult to control oil pumps, especially when the set nominal parameters in electrical networks change.
The variable frequency drive, which is widely used to control installations of electric centrifugal pumps, also helps to reduce stability in case of short-term power outages [1]. These modes of operation are studied by researchers in Russia and abroad [2, 3], and damage from short-term power outages is also assessed [4, 5]. For the uninterrupted operation of electric motors with a frequency-controlled drive, it is proposed to use additional energy storage devices in them [6, 7], and other technical solutions are considered [8–11].

In accordance with GOST 33073-2014, a point at the boundary of the balance sheet or another point closest to the boundary of the section is selected as a monitoring point in the consumer’s electrical networks, where the values of the power quality indicators can be measured.

For this work, readings of three multifunctional electricity meters located on high-voltage lines, which provide the transmission of electricity to the oil fields of EuroSibOil, were selected as the object of research. According to the energy supply agreement, commercial settlements between the last resort supplier and the consumer of electricity were to be made according to the readings of these devices.

All metering points are located on the territory of the Chernozemelsky district of the Republic of Kalmykia - two in the village of Komsomolsky on the feeders of high-voltage lines VL-10 kV "Nadezhdinka" and "Oil" of the electrical substation 110/35/10 kV, and the third - in the neighboring village of Prikumsky on the feeder of VL-10 kV "ChNGDU" electrical substation at the Substation 35/10 kV "Prikumskaya". The metering points are equipped with three-phase multifunctional meters of the BINOM339 type, designed for a rated voltage of $3 \times 57.7 / 100$ (phase 57.7, linear 100) V, with an accuracy class of 0.2S. They differ only in the metering factor: at the substation "Nadezhdinka" - 3000, and at the substations "Oil" and "Prikumskaya" up to - 2000. The specified types of power control and metering devices meet the conditions of GOST, are included in the State Register of Measuring Instruments, certified by the Certification Body of Instrument-Making Products FSUE “VNIIM named after D.I. Mendeleev ”and have a certificate of conformity in the system GOST R No. ROSS RU. ME48.P02789 dated 02.12.2014, and also certified in the voluntary certification system - SDS “GAZPROMTEST” of PJSC Gazprom (certificate of conformity No. GO00.RU.1348.N00266 dated 12.04.2016).

3. Discussions
In accordance with paragraph 4.2 of GOST 32144-2013, the quality of electrical energy in general-purpose power supply systems is determined by the frequency deviation, slow voltage changes, voltage fluctuations and flicker, voltage non-sinusoidal, voltage asymmetry in three-phase systems.

3.1. Frequency deviation
An indicator of power quality related to frequency is the deviation of the value of the main frequency of the power supply voltage, measured in a time interval of 10 s in accordance with the requirements of GOST 30804.4.30, from the nominal value equal to 50 Hz. The frequency deviation in synchronized power supply systems shall not exceed ± 0.2 Hz for 95% of the time interval of one week and ± 0.4 Hz for 100% of the time interval of one week.

When assessing the compliance of electrical energy with quality standards for this parameter, measurements should be made in accordance with GOST 30804.4.30.

3.1.1. Slow changes in the power supply voltage (more than 1 min) are usually caused by changes in the load of the electrical network. Voltage fluctuations at a power transmission point must not exceed 10% of the rated or agreed voltage value for one week.

To establish a slow voltage change, it is necessary to make a measurement after 10 minutes, and within a week only 1008 measurements.

In accordance with the first section of GOST 29322-92, the nominal voltage of three-phase three-wire or four-wire networks since 2003 should be 230 V and 400 V.
3.2. Voltage fluctuations and flicker
Power supply voltage fluctuations (less than 1-minute-long), including single rapid voltage changes, cause flicker.

Power quality indicators related to voltage fluctuations are a short-term dose of flicker, measured in a time interval of 10 minutes, and a long-term dose of flicker, measured in a time interval of 2 hours, at the point of transfer of electrical energy.

According to the current regulations, within a week, doses of flicker should not exceed the following values: short-term - 1.38, long-term - 1.0.

3.3. Non-sinusoidal voltage
Harmonic voltage components are caused by nonlinear loads of users of electrical networks connected to electrical networks of various voltages.

Voltage measurements of harmonic components must be carried out in accordance with the requirements of GOST 30804.4.7.

3.3.1. Voltage asymmetry in three-phase systems is caused by asymmetric loads of consumers of electrical energy or asymmetry of electrical network elements. Power quality indicators are the negative sequence voltage unbalance coefficient and the zero sequence voltage unbalance coefficient.

Voltage unbalance is measured in accordance with the requirements of GOST 30804.4.30.

Under normal network operating conditions, it is recommended to maintain the voltage at the consumer's power point with a deviation from the nominal value of no more than ± 10%.

3.4. Determination of the amount of changes in the payment for electrical energy
The responsibility of the energy supplying organization is stipulated by Article 542 of the Civil Code of the Russian Federation dated January 26, 1996, No. 14-FZ.

4. Conclusion
Commissioning of metering devices installed in the village of Komsomolsky on the feeders of high-voltage lines VL-10 kV "Nadezhinka" BINOM339 No. 80000740 and "Oil" BINOM339 No. 80000739 of the electrical substation 110/35/10 kV, as well as in the village of Prikumsky on the feeder VL-10 kV "ChNGDU" BINOM339 No. 70000280 electrical substation 35/10 kV "Prikumskaya", carried out by representatives of the branch of IDGC of the South, PJSC - "Kalmenergo", which documents the compliance with the requirements for the organization of electricity metering in accordance with the rules for organizing electricity metering in retail markets.

In accordance with the indications of the above metering devices, the amount of the cost of electrical energy not payable by the consumer was determined, in accordance with the requirements of part 2 of Article 542 of the Civil Code, in the amount of the total supplied electrical energy, and in case of payment of such a cost, the cost of such electricity is returned by the supplier.

The permissible duration of a power outage for all reliability categories cannot be more than 72 hours per year, but no more than 24 hours in a row (Federal Law No. 35-FZ of March 26, 2003, Resolution of the Government of the Russian Federation No. 442 of May 4, 2012, Order of the Ministry of Energy of the Russian Federation dated 08.07.2002 No. 204).

As an example, consider a billing period of one full month.

Violation of uninterrupted 24-hour power supply in excess of the permissible excess of 72 hours per year and no more than 24 hours in a row is the basis for reducing the fee.

No such violations were observed for the period from September 1 to September 30, 2019 for the objects under study. However, devices of the account recorded violations of security of supply, most of which were confirmed by air traffic control branch of PJSC "IDGC of South" - "Kalmenergo".

In September 2019, voltage discrepancies with regulatory requirements were observed for the objects under study.

In particular, in accordance with the readings of BINOM339 meters, the total positive and negative deviations of the voltage of the electrical energy receiving point exceeded 10% of the nominal voltage (10 kV) within 100% of an interval of one week. To establish a slow voltage change, the device must
make a measurement in 10 minutes, and within a week - 1008. BINOM339 electricity meters are able to make such a number of measurements.

The cumulative voltage deviation time for 30 days in September 2019 from GOST 32144-2013 at 3 metering points is 15010 minutes or 250.17 hours, of which the meters of the 110/35/10 kV substation in the Komsomolsky settlement showed - installed on the 10 kV overhead line feeder "Nadezhdinka" - 2910 min. or 48.50 hours and installed on the feeder of the VL-10 kV "Oil" - 1970 min. or 32.83 hours; the meter of the 35/10 kV "Prikumskaya" SS in the settlement of Prikumsky, installed on the feeder of the 10 kV overhead line "ChNGDU", showed 10,130 minutes. or 168.84 h.

September data can be considered as close to the average monthly indicators of these objects.

For 12 months (January - December) of 2019, the total electricity consumption was 5,113,189 kWh, of which through the feeders:

- Nadezhink – 1966073.
- Oil – 1117981.
- ChNGDU - 2029135.

The total consumption of low-quality electricity amounted to 3347 hours, of which 1331 hours through the Nadezhink feeders, 223 hours from Oil, and 1793 hours from ChNGDU.

The total consumption of low-quality electricity as a percentage, through the Nadezhink feeders - 12.94, Oil - 2.41, ChNGDU - 22.03, the average for all three facilities is 14.79%.

The total cost of consumed energy at an average tariff of 6.1380 rubles/(kWh) amounted to 31384898 rubles, including the cost of energy passed through feeders: Nadezhink - 8171891, Oil - 4596319, ChNGDU - 9048228.

The amount of the reduction in the payment for low-quality electricity, including VAT, is RUB 4641891, including for the fee passed through the feeders: Nadezhink - 1454424, Oil - 153792, ChNGDU - 3033675.

When making calculations, the prices were used that were presented on the official website of Kalmenergosbyt JSC, as well as data from contracts and invoices of 2019.

The amount of the fee reduction is determined by the duration of the supply of electricity of inadequate quality. For the objects under consideration, in excess of the norm established by the legislation, only voltage deviation was recorded, which in total for all three feeders in annual terms was 14.79%.

The judicial perspective of this case is not clear, since there is no established practice of considering such claims, since in the course of the proceedings it may be revealed that the plaintiff did not comply with certain regulatory requirements. Nevertheless, everything will not remain the same.

The widespread use of multifunctional electricity meters by large electricity consumers with the subsequent use of their readings to draw up statements of claim for going to courts can radically change the economic situation of power grid organizations. They will be forced not only to reduce tariffs by court decisions, but also to establish proper order in the network economy.

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