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Electric power losses in distribution networks 10, 6 and 0,4 kV

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ABSTRACT: The article examines the structure of standard electricity losses in distribution networks of 10,6-0.4 kV. For the convenience of assessing the value of standard electricity losses, it is proposed to express technical losses through the parameter of electricity supply to the network, which is recorded in official reporting.

KEY WORDS: Distribution electrical networks, technical losses, the normative characteristics of electricity losses, equivalent network resistance.

I. INTRODUCTION

Distribution electrical networks of RES 10, 6 and 0.4 kV, which make up the most massive and branched part of electrical networks, energy systems, concentrate in themselves about half of the total value of technical losses of electrical energy. The level of technical losses of electricity in the RES is an indicator of the general state of the electricity metering system and the efficiency of the operation of power grid companies.

Therefore, normalization of losses for the considered period of time, the level of losses acceptable by economic criteria, the value of which is determined on the basis of calculations of losses, analyzing the possibilities in the planning period for each component of their actual structure. When standardizing energy losses, it is necessary to take into account the specifics of the electrical network, the breakdown by voltage classes, the nature of the possible reduction in losses [1].

The standard should be determined on the basis of calculating its actual level and analyzing the possibilities of implementing the identified implementation of the identified decrease.

If we subtract from today's actual losses all the available reserves for their reduction in full, the result can be called optimal losses at the existing network loads and existing equipment prices. The level of optimal losses changes from year to year, as network loads and equipment prices change. If the standard of losses is determined by the prospective load of the network (estimated year), taking into account the effect of the implementation of all economically feasible measures, it can be called a promising standard. In connection with the gradual clarification of these promising standards, it is also necessary to periodically clarify them.

For the implementation of all economically feasible measures, a certain period is required. Therefore, when determining the standard of losses for the coming year, one should take into account the effect only of those activities that can actually be carried out during this period. This standard is called the current regulatory.

The normative characteristics of electricity losses are quite stable and they can be used for a long period until significant changes in the network schemes take place.

The characteristics calculated for existing circuits can be used for 5-7 years. In this case, the error in their reflection of losses does not exceed 6-8%. In the case of commissioning or decommissioning of essential elements of electrical networks during this period, such characteristics give reliable base values of losses, relative to which the effect of the given changes in the circuit on losses can be estimated [2].

For a radial network, the load losses of electricity are expressed by the formula

$$\Delta W_N = \frac{W^2(1+tg\gamma^2)K_f^2}{U^2} * R_{eq}T \qquad (1)$$

Where, W - is the supply of electricity to the grid for the period T; tgγ - reactive power factor; Req - equivalent network resistance; U - average operating voltage.

Equivalent network resistance, voltage and reactive power factor and the shape of the graph vary within relatively narrow limits, they can be "collected" into one factor A, the calculation of which for a specific network must be performed once:

$$A = \frac{(tg\gamma^2+1)K_f^2}{U^2} R_{eq} \qquad (2)$$

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In this case,

$$\Delta W_N = AW^2T \quad (3)$$

Based on a single value, electricity supply to the grid, load losses for any period T.
The characteristic of no-load losses is as follows:

$$\Delta W_x = CT \quad (4)$$

The value of the coefficient C is determined on the basis of the idle power loss ΔP.
Coefficients A and C characteristics of total losses in n radical lines 6-10 or 0.4 kV

$$A = \sum_{i=1}^{n} A_i \left(\frac{W_i}{W_\Sigma}\right)^2 \quad (5)$$

$$C = \sum_{i=1}^{n} C_i \quad (6)$$

where A_i and C_i – are the values of the coefficients for the lines included in the network, W_i- is the supply of electricity to the i-th line; W_Σ- also, in all lines in general [3].
The actual losses in the network for the accounting period W_{rec} are determined by the difference between the electrical energy received by the network W from the sources and the electrical energy paid by consumers W_{eg}

$$W_{rec} = W - W_{eg} \quad (7)$$

Reported energy efficiency losses can be represented

$$\Delta Wrec = Wtech + Wnb \quad (8)$$

Where Wtech – technical losses in network elements, taking into account losses from leakage currents;Wnb unbalance ee in the network. From the expressios (7) и (8),

$$W_{im} = W - W_{ep} - \Delta W_{tech} \quad (9)$$

The imbalance electrical energy can be represented as the sum of two components. The first is caused by the error of changes ΔW_{im} (**im.meter**.) – metrological imbalance, the second - by commercial losses ΔW_{com}.

$$W_{nb} = \Delta W_{im} + \Delta W_{com} \quad (10)$$

When determining these values, it is necessary to take into account the corresponding errors of information measuring systems and unaccounted supply or theft of energy efficiency

$$\Delta W_{norm} = \Delta W_{tech} + \delta W \quad (11)$$

Where ΔW_{tech} - the actual value of technical energy losses, determined taking into account measures to reduce electricity losses; δW – the highest permissible positive value of the metrological non-balance and the permissible value of commercial losses, both components are analyzed under the term "commercial losses".
The value of the standard is not constant and is determined by minimized technical losses, practice indicates that the work of energy enterprises is efficient both in technical and economic terms.
Experts believe that electrical energy losses are acceptable if they are no more than 4-6%, and the level of losses of 12-14% is considered the maximum possible [7]. Energy losses in the networks of power supply companies are key terms that determine the value of the electricity tariff.
Technical losses are calculated for individual sub-stations of the RES, the consumption of energy is known, since the most available data on the composition of the circuit, the parameters of the network elements, the multimode - changes in the parameters of the electrical mode. When applying a certain method for calculating losses, it is necessary to take into account the possibility of obtaining reliable information and the error of the method. All these factors contribute to the use of simplified practical methods for calculating and assessing energy losses, which, in terms of their accuracy, correspond to the completeness of the RES data, its information security. In the literature, various methods for calculating the technological consumption of electrical energy are considered.
The proposed methodology for normalizing losses is based on the algorithm for calculating the technical component of energy losses. The information about the multimode is taken into account by the aspect ratio [8] and the equivalent voltage of the power center [9].

$$К_Ф = \frac{\sqrt{d}}{W_{atp}+W_{rtp}} \left(W_{atp} \sum_к \frac{\sum_{i=1} \sqrt{W_a^2}}{W_{acday}} * \frac{nc\ day}{n_{month}} * W_{rtp} \sum_к \frac{\sum_{i=1} \sqrt{W_{rciday}^2}}{W_{rciday}} * \frac{n_{day}}{n_{month}} \quad (12)$$

$$U_e = \sqrt{0.9U_{max}^2 + 0.1U_{min}^2} \quad (13)$$

Where W_{atp}, Q_{atp} - release of active and reactive electrical energy through the head section of the feeder for a month; d number of intervals; constancy of the daily load schedule; $W_{ac\ day}$, $W_{rc\ day}$ – release of active and reactive electrical energy through the head section of the feeder for one typical day; W_{aciday},W_{rciday}– electrical energy in i-m averaging interval of the daily load schedule; k=I,II,III numbers of characteristic days; n_{day}- number of typical days in the considered month; n_{month} – number of typical days in the considered month; U_{max}, U_{min}- voltage on the buses of the

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power center in the highest and lowest mode; U_e - Equivalent voltage of the power supply center of the RES, taking into account which the calculation of the basic steady-state mode is carried out and the losses of active power in the network elements are taken [4].
When applying the methodology, an averaged value is used for the individual characteristics of the power consumption modes of various fragments of distribution networks, determined according to the head accounting data, are not taken into account, which leads to an error. This assumption insignificantly affects the amount of losses, which is shown by the small variability of the value of the form factor.
For the convenience of assessing the amount of standard electricity losses, it is proposed [technical losses to be expressed through the parameter of electricity supply to the network, which is recorded monthly in the official reporting. For a statistically presented sample of REM circuits, the error in calculating technical losses corresponding to a confidence level of 0.95 for load losses δ_n and no- load losses δ_x.
As a weighted average for average values δ_n, δ_x, the relative error of total technical losses is determined

$$\delta_{tech} = \frac{\delta_n * \Delta W_{nag} + \delta_x * \Delta W_x}{\Delta W_{nag} + \Delta W_x} \quad (14)$$

The boundaries of the range of reliability of the total technical losses electrical energy from the calculated value ΔW_{tech}^{rac} is

$$\Delta W_{tech}^{min} = (1 - \delta_{tech}) * \Delta W_{tech}^{rac}; \ \Delta W_{tech}^{max} = (1 + \delta_{tech}) * \Delta W_{tech}^{rac} \quad (15)$$

For the mean of the data, δ_n=0,075, δ_x=0,01 is estimated to range from 4.3 to 7%. Within this interval, the values may correspond to the actual electrical energy losses. It should be noted that the standard value of losses is not a constant value and depends to a greater extent on the supply of electricity to the network. Under normal conditions of electrical energy transmission for the reported losses in the network, the condition must be met

$$\Delta W_{otch} \leq W_{norm} = \Delta W_{tech}^{rac} + \delta W \quad (16)$$

If the reported losses exceed the calculated value of the standard $\Delta W_{otch} > W_{norm}$, then this indicates the presence of theft. If $\Delta W_{otch} < W_{norm}$ - this indicates an intentional underestimation of losses.
Thus, taking into account the influence of the structure, along with the load of the network, gives a margin of error in calculating the load components of the losses of electrical energy in the lines ΔW_l and transformers ΔW_{tr} conclusions [4-5].

II. CONCLUSION

1. The methodology for determining the rate of loss with different levels of information security in distributed networks makes it possible to assess the energy loss and identify it without metering electricity consumption.
2. The proposed procedure for calculating the standard of losses through the recorded reporting parameter of the supply of electricity to the network is acceptable for practical and engineering calculations.

REFERENCES

1. Zhelezko Yu.S. Loss of electricity. Reactive power. Power Quality: A Practical Guide Calculations-m.: ENAS, 2009, - P.456.
2. Zhelezko Yu.S., Artemiev A.V., Savchenko OV Rationing of technological losses of electricity in networks - a new calculation methodology II news of electrical engineering, - №5, 2003, - P.23-27.
3. Zhelezko Yu.S. The choice of measures to reduce the loss of electricity in electric networks: a guide for practical calculations – M.: Energoatomizdat, 1989, - P.176.
4. Gerasimenko A.A., Bobrov A.E., Tikhonovich A.V. Assessment of normative losses of electricity in distribution electric networks II Optimization of operating modes of electrical systems: interuniversity colleges and research papers – Krasnoyarsk, 2006, - P.184-199.
5. Fursanov M.I. Determination and analysis of electricity losses in electrical networks of power systems. - Minsk. KILLER at UP. "Belenergosberezhenie", 2005, - P.2007.

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