

Increasing the bandwidth of networks by moving to a higher voltage class

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Abstract – The feature of domestic distribution electrical networks is the physical deterioration of fixed assets. At the same time, electricity consumption is increasing every year. This creates the need to upgrade the power grids and increase their bandwidth. It is proposed to carry out the modernization of the networks with the simultaneous transition to the higher voltage class of 20 kV.

Keywords – bandwidth, physical deterioration, modernization, voltage class, transformer.

Introduction

The peculiarity of distribution electric networks, like most rural electric networks of Ukraine, is their considerable length due to the relatively small power that they transmit. Typical power supply voltage is 10 kV, and operating mode – with isolated neutral.

The using of obsolete equipment complicates the operation and repair of network equipment, as spare parts for such equipment are no longer produced. Therefore, domestic networks often require radical upgrades.

Main Material

The analyzed electrical network (Fig. 1) has been in operation since 1970. Fixed assets are physically worn out. Percentage of transformer substations (TS) in need of overhaul – 27%, the rest of TS need to be reconstructed. At the same time, electricity consumption is increasing every year [1].

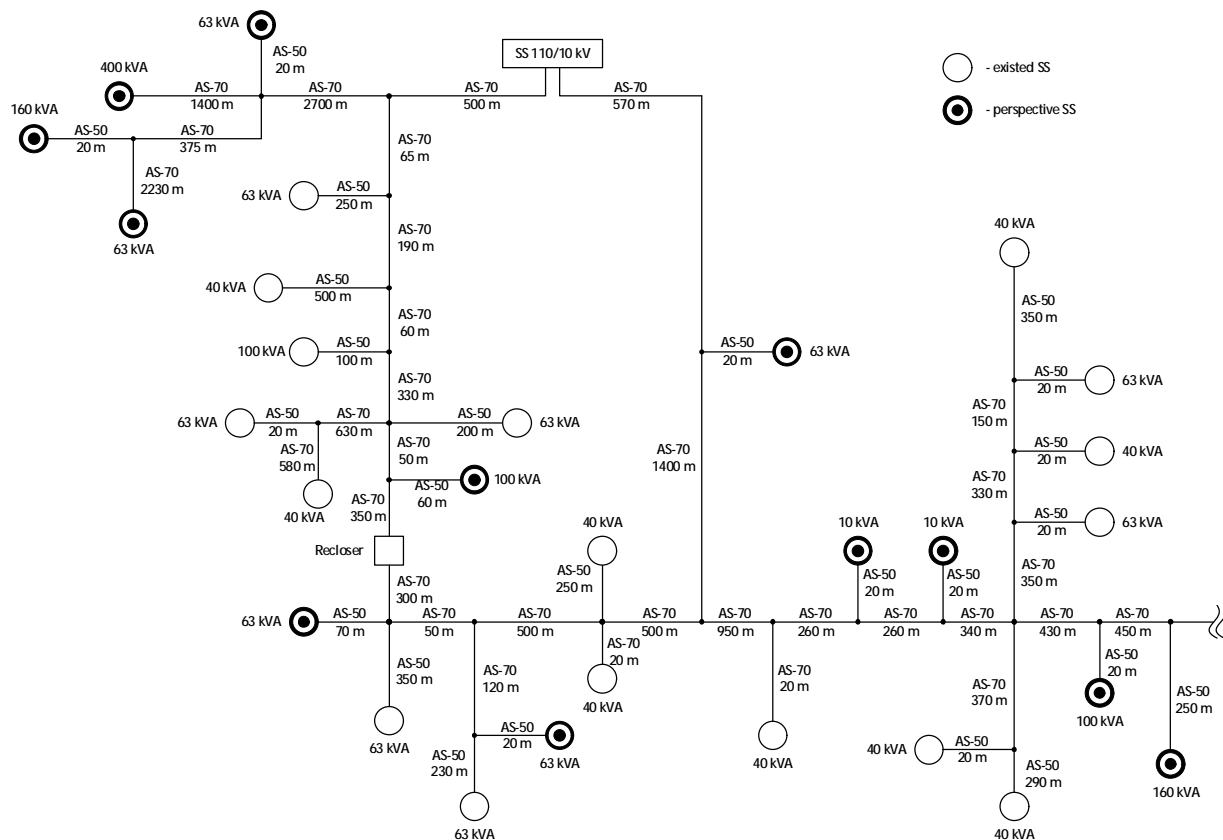


Fig.1. The scheme of the electrical network part for the 110/10 kV substation

At first, it is necessary to estimate the growth of electricity consumption of consumers that are connected to the network in accordance with the current normative documents.

The prognosis of the level of loading is carried out in accordance with the methodology given in the GID 34.20.178: 2005 [2] and based on current electricity consumption data, broken down by customer groups. As of 2017, the share of industry was 8%, agricultural consumers – 1.9%, electric transport – 0.7%, construction sector – 0.4%, communal households – 18.1%, population – 52%, other consumers – 2.6%. Losses in networks make up 16.3%. Total actual power of consumers - 2880 kVA.

According to calculations, the volume of electricity consumption in the next 10 years will increase by almost 40% and will reach almost 4,000 kVA.

Since fixed assets are in need of reconstruction, in order to increase the throughput of networks, it is proposed to switch to a higher voltage of 20 kV. This will require the modernization of all 10/0.4 kV transformer substations, as well as the 110/10 kV district substation. It will also require a partial change in the configuration of electrical networks and the installation of additional transformer substations (see Fig. 1).

The results of calculation of the perspective maximum mode of 20 kV shows that at all substations the required supply voltage is provided.

In order to ensure the gradual replacement of the 10 kV power grid by a 20 kV power supply, a new transformer TMN-6300/110-U1 110/20 kV is proposed at the district substation in addition to the existing transformer 110/10 kV with the retrofitting of the 110 kV voltage transmission line and the equipment of the RU-20 kV for new transformer. After complete transfer of the 10 kV power grid to the electricity supply system of 20 kV, the equipment of the existing circuit with TM 110/10 kV must be dismantled.

Note also that the proposed solution requires an additional definition of the conformity of existing elements of distribution electrical networks to the requirements of reliability and quality of electricity supply to consumers. Such technical justification should be performed in compliance with the JMA - H MPE 40.E20.576: 2005 [3] and SOBU MEVE EE 40.1-00100227-01: 2016 [4].

Conclusion

Domestic energy networks require radical modernization. Therefore, the approach proposed in the article of increasing their bandwidth through the transition to a higher voltage class is appropriate.

Acknowledgments

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