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OPTIMIZATION OF THE FUNCTIONING OF 10–35 KV DISTRIBUTION NETWORKS USING AUTOMATED SECTIONALIZING POINTS (RECLOSER)

Ensuring a stable and efficient power supply is one of the key challenges of modern energy systems, especially for high-voltage networks of 10-35 kV, which constitute a significant part of the overall power grid. Constant changes in consumption modes, voltage fluctuations, failures in relay protection and automation, and other unpredictable factors accompany the operation of these networks. An additional challenge is the physical damage to equipment caused by military actions, which negatively impacts the entire system's stability.

To enhance the reliability of the power supply, it is necessary to modernize the infrastructure using advanced technologies. One of the most effective solutions is the implementation of vacuum reclosers – devices that automatically respond to emergencies, prevent prolonged outages, and minimize power losses for consumers. The continuous improvement of these devices allows for faster power restoration and increases the efficiency of power networks.

The recloser constantly analyzes real-time power line data through current transformers and voltage sensors. When a fault is detected, and voltage, current, or frequency levels surpass the preset limits of the microprocessor relay protection system, the control unit triggers a signal to operate the switching module mounted on the pole [1]. The recloser can be used for simple protection functions and complex automation algorithms for distribution networks.

The effectiveness of the power supply can be assessed using the SAIDI index, which determines the average duration of power outages per customer over a specific period. In developed countries, this indicator usually does not exceed 100 minutes per year, whereas in Ukraine, in 2022, it reached 1402 minutes, compared to 1500 minutes before the war [2].

Analysis of global experience shows that introducing incentive-based regulation can significantly reduce this indicator.

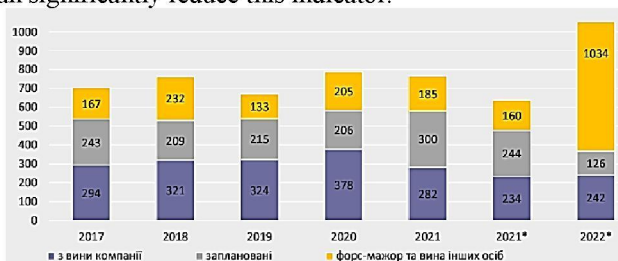


Figure 1 - SAIDI indicators for the first half of 2017-2022, min

The practical implementation of distributed sectioning systems based on reclosers confirms their effectiveness in improving network reliability. An example of the modernization of a substation demonstrates that after automation, the SAIDI index decreased to 600 minutes, which is nearly 3.5 times less than in a traditional 10 kV network. This figure decreased even further for consumers connected to backup sources – to 56 minutes [3].

The deployment of vacuum reclosers in high-voltage networks of 10-35 kV significantly enhances their stability and speed of power restoration. In conditions of wartime instability, such technological solutions are critically important, as they contribute to the modernization of the power system and significantly reduce the frequency and duration of power outages. This not only improves the quality of electricity supply but also positively impacts the economy and the daily lives of consumers.

REFERENCES

1. Andrikeeva S. A. Usage Optimization of Automatic Points of Sectionalizing to Increase Grid Reliability and Electricity Service [Electronic resource] / S. A. Andrikeeva, A. M. Gel'fand, V. R. Dubonos et al. // Power Technology and Engineering. – 2017. – Vol. 50. – P. 556–559. – Access mode : <https://doi.org/10.1007/s10749-017-0750-y/> (accessed: 2025.03.15).
2. Левченко О. П. Дослідження шляхів підвищення надійності роботи електромережевого господарства АПК України у сучасних умовах життя [Електронний ресурс] / О. П. Левченко, Ю. О. Семчишина // Електроенергетика, електромеханіка та технології в АПК : наукові пошуки молоді : всеукр. наук.-практ. конф., 2 квітня 2024 р. : тези доп. – Харків: Держ. біотехнологічний ун-т, 2024. – С. 21–22. – Режим доступу : https://repo.btu.kharkov.ua/bitstream/123456789/52218/3/Konf_YeY_ET_APK_MOLOD_24-21-22.pdf/ (дата звернення: 2025.03.15). – Назва з екрану.
3. Бахметьев В. В. Підвищення ефективності роботи розподільчих мереж ліній 10-35 кВ за рахунок автоматичних пунктів секціонування / В. В. Бахметьев, О. П. Левченко, Л. Б. Жорняк // Електроенергетика, електромеханіка та технології в АПК : міжнар. наук.-практ. конф., 6 листопада 2024 р. : тези доп. – Харків : Держ. біотехнологічний ун-т, 2024. – С. 16–17.