

AUTOMATION OF PUMPING STATIONS IN WATER SUPPLY SYSTEMS

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ABSTRACT. *This article analyzes the importance and advantages of automating pumping stations in water supply systems. Pumping stations play a key role in ensuring the reliable and continuous delivery of water to consumers. Traditional control methods often lead to high energy consumption, unstable pressure levels, and increased operational costs. The article discusses the use of sensors, programmable logic controllers (PLC), variable frequency drives (VFD), and SCADA systems in the automation of pumping stations. It is noted that the application of frequency-controlled pumps can reduce energy consumption by up to 20–30 percent. Automated pumping stations also help maintain stable hydraulic conditions in the water supply network, improve pipeline reliability, and reduce maintenance costs. The results of the study indicate that the automation of pumping stations is an important direction for the modernization of water supply infrastructure.*

Keywords: *water supply system, pumping station automation, programmable logic controller (PLC), variable frequency drive (VFD), SCADA system, energy efficiency, pressure control, automated monitoring.*

ANNOTATSIYA. *Ushbu maqolada suv ta'minoti tizimlarida nasos stansiyalarini avtomatlashtirishning ahamiyati va afzalliklari tahlil qilingan. Nasos stansiyalari suvni iste'molchilarga uzluksiz va barqaror yetkazib berishda muhim rol o'ynashi ta'kidlangan. An'anaviy boshqaruv usullarida energiya sarfining yuqoriligi, bosimning beqarorligi hamda ekspluatatsiya xarajatlarining ortishi kabi muammolar yuzaga kelishi qayd etilgan. Maqolada nasos stansiyalarini avtomatlashtirishda sensorlar, dasturlanadigan mantiqiy kontrollerlar (PLC), chastota o'zgartirgichlar (VFD) va SCADA tizimlaridan foydalanish masalalari ko'rib chiqilgan. Shuningdek, chastota orqali boshqariladigan nasoslarni qo'llash energiya sarfini 20–30 foizgacha kamaytirishi mumkinligi asoslab berilgan. Avtomatlashtirilgan nasos stansiyalari orqali suv ta'minoti tarmog'ida gidravlik rejimni barqarorlashtirish, quvurlar ishonchligini oshirish va ekspluatatsiya xarajatlarini kamaytirish imkoniyatlari yoritilgan. Tadqiqot natijalari suv ta'minoti infratuzilmasini modernizatsiya qilishda nasos stansiyalarini avtomatlashtirish muhim yo'nalish ekanligini ko'rsatadi.*

Kalit so'zlar: *suv ta'minoti tizimi, nasos stansiyasini avtomatlashtirish, dasturlanadigan mantiqiy kontroller (PLC), chastota o'zgartirgich (VFD), SCADA tizimi, energiya samaradorligi, bosimni boshqarish, avtomatik monitoring.*



Water supply systems play a crucial role in ensuring reliable and continuous delivery of water to residential, industrial, and municipal consumers. Pumping stations are one of the key elements of these systems, as they maintain the required pressure and ensure the transportation of water through pipelines. In traditional water supply systems, pumping stations are often operated manually or with limited control mechanisms, which can lead to inefficient energy consumption, unstable pressure levels, and increased operational costs. Therefore, the automation of pumping stations has become an important technological solution aimed at improving the efficiency and reliability of water supply systems.

Automation systems in pumping stations are designed to monitor and regulate the operational parameters of pumps, such as pressure, flow rate, water level, and energy consumption. These systems typically include sensors, programmable logic controllers (PLC), frequency converters, and supervisory control and data acquisition (SCADA) systems. Sensors continuously measure system parameters and transmit the collected data to the control unit. Based on the received information, the automation system adjusts the operation of pumps, ensuring stable water supply while minimizing energy consumption.

One of the most effective technologies used in automated pumping stations is the application of variable frequency drives (VFD). These devices allow the pump motor speed to be regulated according to the actual water demand in the network. As a result, the system avoids unnecessary pump operation at full capacity, which significantly reduces electricity consumption and mechanical wear of equipment. Studies show that the use of frequency-controlled pumps can reduce energy consumption by up to 20–30 percent.

Pumping Station Automation System

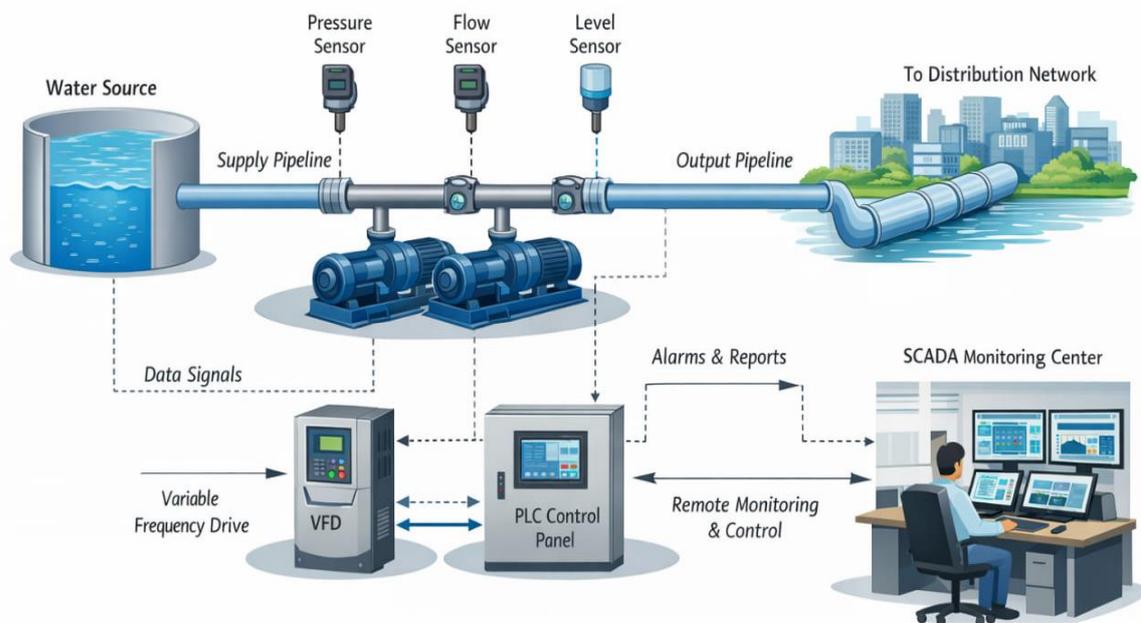


Figure 1. Technological Scheme of an Automated Pumping Station in a Water Supply System.



Another important aspect of pumping station automation is remote monitoring and control. Modern SCADA systems enable operators to supervise the operation of pumping stations in real time, detect failures, and take corrective actions without being physically present at the facility. This improves system reliability, reduces downtime, and allows faster response to emergency situations.

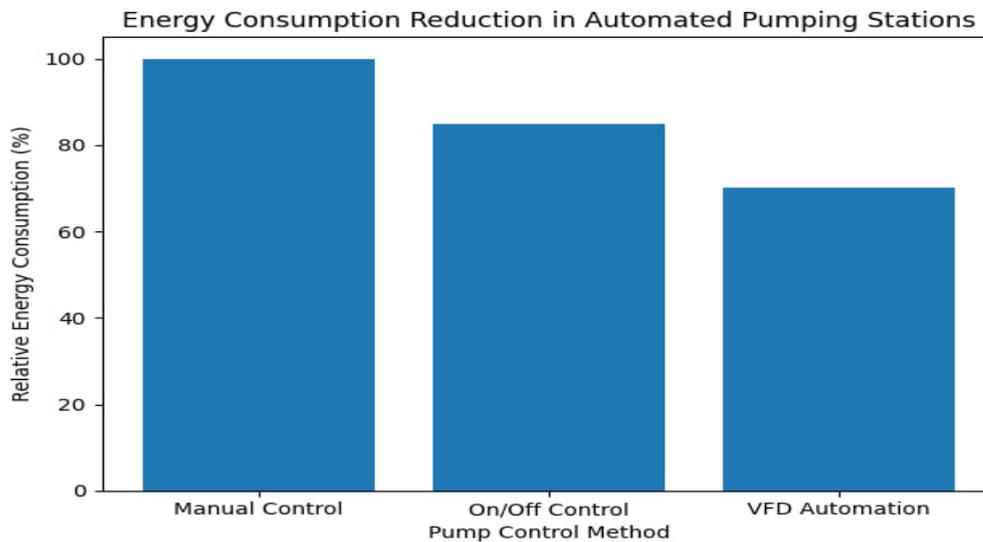


Figure 2. Energy Consumption Reduction in Automated Pumping Stations

In addition, automated pumping stations help maintain optimal hydraulic conditions within the water supply network. By continuously adjusting pump performance according to pressure and flow requirements, the system prevents pressure fluctuations, reduces pipeline stress, and extends the service life of infrastructure components.

In conclusion, the automation of pumping stations is an essential step toward improving the efficiency, reliability, and sustainability of water supply systems. The implementation of modern control technologies, including PLC-based systems, frequency converters, and SCADA platforms, can significantly reduce operational costs, enhance energy efficiency, and ensure stable water distribution for consumers. Therefore, the development and implementation of automated pumping stations should be considered a priority in the modernization of water supply infrastructure.

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