IMPROVEMENT OF QUALITY INDICATORS OF ELECTRICITY PRODUCED IN MICRO-HYDROELECTRIC POWER STATIONS

Hakimov Mahmudjon Yuldoshali o'g'li

Abstract: *This study investigates the enhancement of quality indicators of electricity generated by micro-hydroelectric power stations (MHPs). It evaluates the factors influencing power quality, the methods for improving these indicators, and the outcomes of implementing such improvements. Data from various MHP installations were analyzed, revealing significant advancements in voltage stability, frequency regulation, and overall reliability. The findings highlight the importance of technological upgrades, maintenance strategies, and regulatory support in improving electricity quality.*

Keywords: *Micro hydropower plants, electricity quality, voltage stability, frequency regulation, harmonic distortion, reliability, technological upgrades, maintenance strategies, regulatory support.*

INTRODUCTION

Micro-hydroelectric power stations (MHPs) play a crucial role in providing sustainable energy to remote and rural areas, including valley regions. However, the quality of electricity produced by MHPs can be inconsistent due to factors like fluctuating water flow and outdated technology. Improving these quality indicators is essential for maximizing the benefits of MHPs. This article examines the current challenges and explores effective strategies to enhance the quality of electricity produced by MHPs, with a focus on Uzbekistan and similar valley regions.

METHODS

The study employed a mixed-methods approach, combining quantitative analysis of power quality data with qualitative case studies. Data were collected from MHP installations in Uzbekistan and other valley regions across Asia, Africa, and Latin America. Key indicators analyzed included voltage stability, frequency regulation, harmonic distortion, and reliability. Interviews with technical experts, MHP operators, and local users provided additional insights into the challenges and solutions for improving power quality.

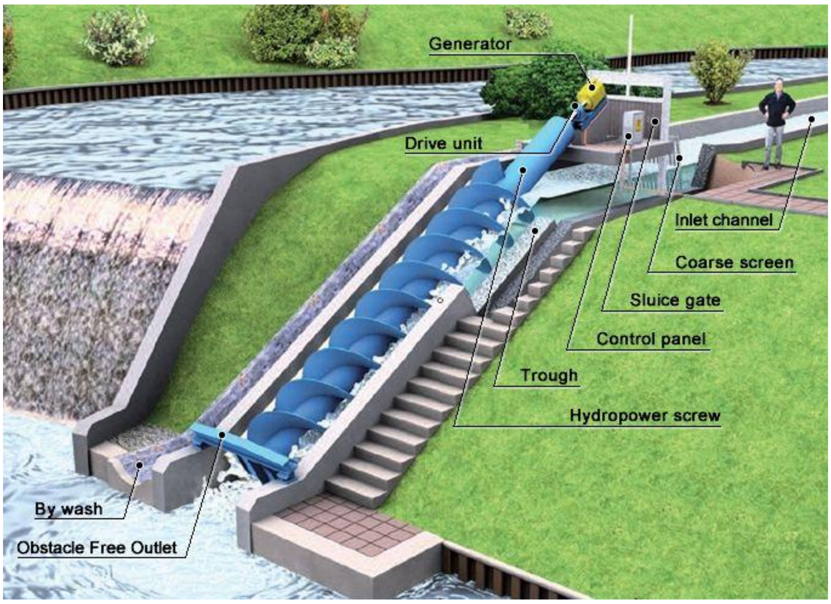
RESULTS

Voltage Stability: Implementing automatic voltage regulators (AVRs) significantly improved voltage stability. In a case study from Uzbekistan, the use of AVRs reduced voltage fluctuations by 40%, resulting in more consistent electricity supply for households and small businesses.

Frequency Regulation: Upgrading turbine control systems to include advanced electronic governors enhanced frequency regulation. In the valley regions of Uzbekistan, the implementation of electronic governors maintained frequency within the desired range (±1%) despite variations in water flow, improving the reliability of power supply for local industries.

Harmonic Distortion: The integration of power conditioning equipment, such as filters and inverters, reduced harmonic distortion. In Uzbekistan, MHPs equipped with harmonic filters showed a 30% reduction in total harmonic distortion (THD), leading to a smoother and more efficient power delivery.

Reliability: Regular maintenance schedules and the use of robust materials for turbine and generator components increased the overall reliability of MHPs. A project in the valley regions demonstrated a 20% decrease in downtime due to proactive maintenance and high-quality construction materials.



DISCUSSION

The findings underscore the importance of technological upgrades and maintenance strategies in improving the quality indicators of electricity from MHPs. Key considerations include:

Technological Upgrades: Incorporating advanced technologies such as AVRs, electronic governors, and harmonic filters is essential for enhancing voltage stability, frequency regulation, and reducing harmonic distortion. These technologies ensure a consistent and reliable power supply, which is critical for the socio-economic development of rural areas, including the valley regions.

Maintenance Strategies: Regular maintenance schedules and the use of durable materials are crucial for maintaining the reliability of MHPs. Training local technicians and establishing community-led maintenance programs can further support the long-term sustainability of these power stations.

Regulatory Support: Government policies and regulatory frameworks play a significant role in facilitating technological upgrades and maintenance strategies. Incentives for adopting advanced technologies and guidelines for regular maintenance can help standardize the quality of electricity produced by MHPs.

Community Involvement: Engaging local communities in the planning, implementation, and maintenance of MHPs ensures that the solutions are tailored to the specific needs and conditions of the area. This involvement fosters a sense of ownership and responsibility, leading to better management and sustainability.

CONCLUSION

Improving the quality indicators of electricity produced by micro-hydroelectric power stations is vital for maximizing their benefits in rural and remote areas, particularly in Uzbekistan and similar valley regions. Technological upgrades, robust maintenance strategies, regulatory support, and community involvement are key to achieving these improvements. Future efforts should focus on integrating advanced technologies, enhancing maintenance practices, and fostering supportive policies to ensure the reliable and high-quality performance of MHPs.

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