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DIGITALIZATION CHALLENGES FOR HYDROPOWER PLANTS – INSIGHTS FROM A DRINKING WATER RECOVERY EXAMPLE

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Abstract: Hydropower sector is undergoing a transformation of replacing old analog control systems and leveraging the effect of digitalization to increase operational flexibility, production and safety using digital elements like sensors, wireless platforms, real time monitoring, predictive maintenance and decision support systems etc.. Implementation of digitalization to hydropower plants has a potential of 42 TWh increase in annual production worldwide, hence creates a potential for USD 5 billion annual operational cost savings and reduction in greenhouse gas emissions. One of the critical and common applications of digitalization in hydropower sector is unmanned/remote operated hydropower plants, of which there are several examples of in the Water-Energy nexus projects. In Water Distribution Networks (WDN), Pressure Reduction Valves (PRV) are the most common tools to manage excessive pressure due to the topography, resulting in energy waste. To harvest this waste energy, micro hydropower plants can be used for pressure reduction and the harvested energy can be used in remote areas lacking grid connectivity or directly supplied to the local grid. Digitalization has potential advantages on both micro, mini and small sized hydropower plants installed in water networks such as optimal control of water pressure using digital twins of the WDNs, autonomous operation of the plants and proactive or predictive maintenance to ensure trouble-free operation. In this paper, we present the insights from a technical point of view from a practical Water-Energy nexus project and from a short term scientific mission study conducted with a COST action PEN@Hydropower member institute. This research aims to reveal main challenges to be encountered during implementation of digital control and monitoring solutions in a small hydropower plant, including hands on observations during erection, commissioning and operation phases. Review on data collection and storage issues from critical equipment, cleaning out the collected data for analysis and machine learning applications, cyber security issues brought by digital transformation along with the convenience in installation and operation it brings is presented as a guide for future research.

Keywords: Hydropower, digitalization, water-energy nexus

INTRODUCTION

With the global hydropower fleet aging, the need for plant refurbishment, including modernization and digitalization, has become increasingly urgent. Worldwide, approximately 50% of hydropower plants are over 40 years old. In Europe, it is estimated that upgrading and refurbishing aging hydroelectric plants could yield an additional 9.4% in energy generation [1]. The Hydropower Special Market Report projects that between 2021 and 2030, USD 127 billion—nearly one-quarter of the total global hydropower investment—will be allocated to modernizing aging hydropower fleets, particularly in advanced economies [2]. These investments are expected to enhance plant output by 5–10% through modernization and digitalization, improving operational flexibility, efficiency, and safety while also addressing environmental and societal challenges [3], [4], [5], [6], [7], [8].

The implementation of digital technologies in hydropower plants has the potential to increase annual global electricity production by 42 TWh, leading to an estimated USD 5 billion in annual operational cost savings and a significant reduction in greenhouse gas emissions [4]. In addition to digitalization, energy recovery from drinking water networks enhances sustainability by converting excess hydraulic energy into electricity, thereby improving energy efficiency and reducing operational costs. This process typically involves the installation of microturbines or pumps-as-turbines (PATs) at points of excess pressure within water distribution systems. For example, a study conducted in Trabzon-Karakaya, Turkey, demonstrated that integrating microturbines into pressure reduction valves could generate approximately 84.12 kWh of electricity per hour, sufficient to meet the hourly energy demands of 311 households [9]. Furthermore, technologies such as the GreenValve have been developed to recover energy in

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water distribution networks, contributing to the transition toward net-zero energy systems [10].

The contributing institutes from Norway and Turkey, both members of the COST Action PEN@Hydropower initiative, represent two of the leading hydropower producers in Europe. As of 2023, Norway's installed hydropower capacity stands at approximately 33.9 gigawatts (GW), making it the largest in Europe, while Turkey follows closely with around 32.5 GW [11].

1. DIGITALIZATION STUDIES IN HYDROPOWER PLANTS

One of the primary objectives of digitalization in hydropower plants is the implementation of state-of-the-art control equipment in automation systems. These systems are capable of collecting data from hundreds of sensors simultaneously at high time resolutions and transmitting it to SCADA servers for further analysis. Beyond ensuring the safe and reliable monitoring and control of the plant, modern SCADA systems offer advanced data storage capabilities, enabling the analysis of critical subsystems through various data manipulation techniques and machine learning methods. An example of a typical modern control system with an integrated anomaly detection module is presented in Figure 1. Such advanced systems allow power plant operators to aggregate and analyze data from multiple power plants, facilitating informed decision-making for production planning and maintenance activities.

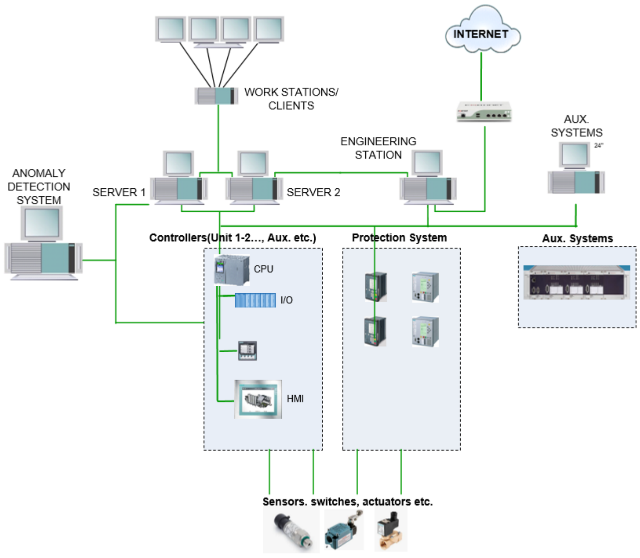

Figure 1: SCADA with anomaly detection support architecture example

In France, EDF (Électricité de France), with an installed hydropower capacity of 20,300 MW, has implemented a SCADA system in every run-of-river power plant to monitor and control water levels, allowing the company to regulate power generation based on demand [12]. In the study conducted by Myint et al., SCADA was utilized to develop forecasting models for a hydropower plant (HEPP). The essential data used to achieve the study's objectives is summarized in Table I [13].

Table I: Essential Data Resources from HPPs

No.	Collection Data	For objective items
1	Active power (W)	Power line, transformers and generators
2	Current (A)	
3	Voltage (V)	
4	Frequency (Hz)	
5	Power factor	
6	Temperature (^{o}C)	Transformers, thrust bearing, upper guide bearing, lower guide bearing, turbine guide bearing, stator coil
7	Pressure (Pa)	Water Inlet (Penstock), water outlet (draft tube)
8	Water Level (m)	Upstream and downstream
9	Vibration (m/s^2)	Rotor
10	Flow of water (m/s^2)	Cooling water system for all bearing, shaft seal

The data sources selected from the most critical equipment in a hydropower plant, as presented in Table II, are considered to be the primary contributors to failures and malfunctions, according to condition monitoring systems operating in power plants in the study by Betti et al. [14]. In that study, a Self-Organizing Map (SOM)-based Key Performance Indicator (KPI) system was used to generate anomaly warnings, helping to prevent unexpected shutdowns. As a result, this approach led to cost savings of approximately €25,000 to €100,000 in power generation.

Table II: Data Sources from Study of Betti et al.

Component Name	Measured Signals	Number of sensors
Generation Units	Vibrations	34
HV Transformer	Temperatures Gasses levels	27
Turbine	Pressures Flows Temperatures	27
Oleo-dynamic system	Pressures Temperatures	20
Supports	Temperatures	54
Alternator	Temperatures	43

In the study by Welte and Foros, the digital modeling of subsystems in hydropower plants is categorized into five complexity levels, considering nine different cases, as shown in Figure 2 [15]. The report suggests that for relatively simple and easily observable studies, such as the condition monitoring of drainage pumps (C2), physics-based methods— including the monitoring of on-off cycles of the motors—are appropriate. However, for more complex cases, such as vibration monitoring of rotating equipment (C4), more advanced and data-driven methods are applied.

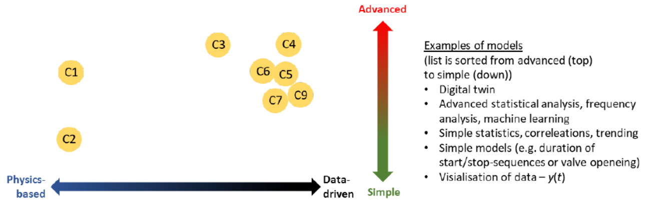

Figure 2: Classification of Anomaly Detection Problems

Machine learning-based digital modeling methods have been applied in various studies to analyze rotary equipment in different types of power plants, including hydropower, combined cycle, and thermal power plants [16], [17], [18], [19], [20]. The analysis of asset performance using healthy-state data and machine learning (ML) models has significantly impacted power plant operations in terms of economic efficiency, performance optimization, and safety improvements [21], [22]. Such modeling studies, which contribute to digitalization in power plants, enable the comparison of normal behavior models with real-time system data. The normal behavior approach involves modeling a system at the beginning of its life cycle and continuously comparing it with live data from automation systems to detect anomalies and generate alerts when deviations occur [23].

Kougias et al. propose the "Digital Avatar" method, which integrates physical engineering with data science to enhance grid services. The Digital Avatar approach, illustrated in Figure 3, helps reduce the risks of unexpected outages while improving safety and reliability. This is achieved by extending the operating range and accelerating system dynamics.

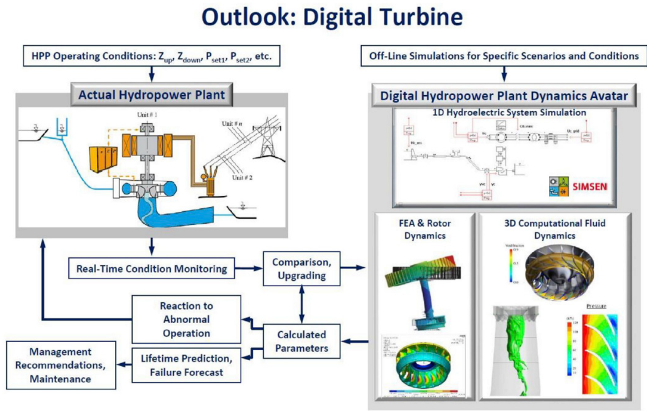

Figure 3: Information Flow&Exchange of a Digital Avatar by Kougias et al.

In a study by Vagnoni et al., it was found that hydropower plays a crucial role in enhancing grid flexibility across 15 European countries. However, the modernization of hydropower plants is a significant challenge. The flexible operation of these plants forces the units to operate under off-design conditions, which in turn reduces their overall lifespan [24]. The same study advocates for the use of machine learning applications in the energy sector, highlighting their potential to manage big data and promote sustainability.

Without digitalization, achieving effective prognostics and condition-based maintenance in power plants becomes difficult. The condition of a rotating machine can be categorized into three phases: healthy condition, gradual development of small faults, and the rapid escalation of significant faults leading to failure. Vibration analysis, a common condition-based maintenance approach, typically involves the installation of sensors near rotating components, as shown in Figure 4 [25].

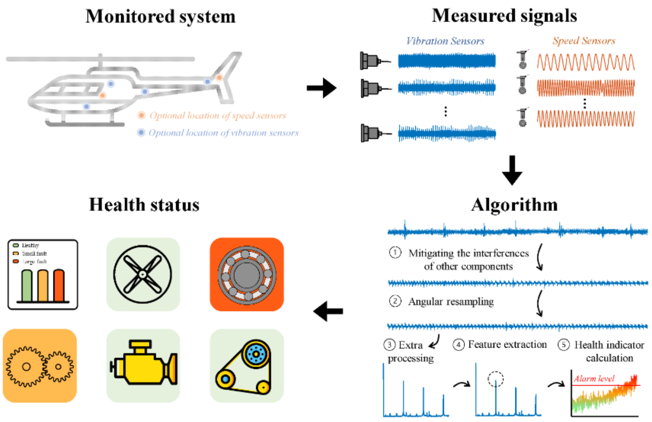

Figure 4: Condition-based maintenance by vibration analysis: use of vibration and speed sensors for monitoring the rotating machinery

Smart sensing techniques are effective tools for monitoring a physical system in terms of geometrical modeling, operational status, and environmental conditions, particularly for predictive maintenance. These techniques address the limitations of traditional fault diagnosis methods by evaluating the effects of mechanical degradation over time [26]. The process flow is illustrated in Figure 5.

Using a machine learning-based optimization algorithm, the Xflex Hydro team updated the cam curves of a Kaplan-Bulb runner to account for changes due to years of operation. This update resulted in an approximately 2% increase in production (simulation). Additionally, through digitalization, they implemented a Full-Size Frequency Converter on a 5 MW reversible pump-turbine, which reduced response time and thereby increased flexibility [27], [28].

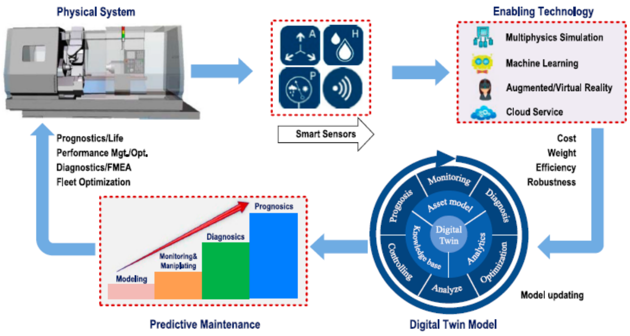

Figure 5: Digital Twin enabled fault diagnosis framework

2. DIGITALIZATION CHALLENGES IN DRINKING WATER RECOVERY HPPS

Digitalization in drinking water recovery hydropower plants (HPPs) faces several challenges, including high implementation costs, cybersecurity risks, and data integration complexities. Many existing water infrastructure systems are outdated, which complicates the integration of modern digital monitoring and control technologies. Additionally, ensuring data security and protecting against cyber threats is essential, as water supply systems are considered critical infrastructure. Overcoming these challenges requires investment in advanced sensors, secure data management systems, and workforce training to optimize both efficiency and sustainability. The following challenges, identified from similar studies in the literature and insights from two drinking water energy recovery power plant projects in Turkey, with installed capacities of 500 kW and 2.5 MW, are outlined.

2.1. Data Collection and Storage Issues

Drinking water energy recovery hydropower plants (HPPs) face several challenges in data collection and storage, which are critical for optimizing operations and ensuring sustainability. A significant issue is the existence of data silos, where different departments or units operate incompatible data systems, impeding effective data sharing and collaboration. This fragmentation can lead to inefficiencies and difficulties in identifying operational issues. Implementing integrated data collection and storage systems can mitigate this problem by consolidating data from various sources into a unified platform, enhancing accessibility and decision-making [29]. Moreover, managing large volumes of data from diverse sources introduces challenges in maintaining data quality and credibility. Establishing standardized data collection methodologies and formats is essential to ensure accurate analysis and informed decision-making. A coordinated approach to data management, which includes adopting risk-based strategies and aligning resources effectively, can enhance data reliability and support the efficient operation of HPPs [30]. In the experienced projects, operationally critical data, such as bearing temperatures, vibrations, and governor pressure, will be stored and evaluated on local servers to ensure response speed and reliability. Less critical, yet still valuable, summarized data will be transmitted, stored, and monitored via existing SCADA systems of the water and sewage administration, alongside other pump stations and water distribution networks.

2.2. Operational Challenges

Drinking water recovery hydropower plants (HPPs) face several operational challenges that affect their efficiency and long-term sustainability. One of the primary issues is the variability in water flow and pressure, as fluctuations in consumer demand and seasonal changes can reduce the consistency of energy generation [31]. In rural areas, the lack of robust electricity transmission infrastructure makes it difficult to integrate small HPPs into the national grid. Compatibility issues with the national grid include difficulties during grid connection tests, excessive loading of the connected transmission line, and regulatory concerns arising from insufficient allocated transformer capacity. The costs associated with grid extension and maintenance can be high, limiting the feasibility of these projects. Although small HPPs have lower operational costs, the initial capital investment for dam construction, turbines, and electrical infrastructure can be significant. To mitigate these costs, pilot projects with capacities of 2.5 MW and 500 kW typically utilize existing piping from drinking water networks and are constructed over parallel lines to the existing pressure reduction valves (PRVs), resulting in a substantial reduction in structural costs. Since these plants are integrated into existing water networks, their operation is coordinated with the existing automation systems to manage the network as a whole, prevent water loss, and balance pressure and loading pool levels. Navigating the permitting and regulatory processes for small HPPs can be complex and time-consuming, with compliance requirements for environmental laws, water rights, and safety standards adding to administrative burdens.

2.3. Cyber Security Issues

Small hydropower plants (HPPs) face increasing cybersecurity challenges as they incorporate digital technologies for monitoring, control, and automation. These challenges arise from limited resources, outdated infrastructure, and the growing cyber threats targeting critical energy infrastructure. Small HPPs often operate under constrained budgets, making it difficult to invest in advanced cybersecurity measures, specialized personnel, and ongoing security updates. Unlike large-scale power plants, small HPPs may lack dedicated IT teams to manage cybersecurity risks. With an increasing reliance on remote monitoring and automation, these plants become prime targets for cyberattacks, including ransomware, data breaches, and unauthorized access. Poorly secured remote access points and weak authentication protocols heighten their vulnerability. Additionally, many small HPP operators and staff may not be adequately trained in cybersecurity best practices, leading to human errors such as weak password management, phishing attacks, or neglecting regular software updates. To mitigate these cybersecurity risks, small HPPs should implement robust authentication protocols, regularly update software and firmware, provide cybersecurity training for employees, and use network segmentation to isolate critical systems from external threats. Collaborating with cybersecurity experts and leveraging government support programs can further strengthen resilience against cyber threats.

3. CONCLUSION

Digitalization presents significant opportunities for improving the efficiency, reliability, and sustainability of hydropower plants (HPPs), particularly in the context of drinking water energy recovery systems. By leveraging advanced monitoring, automation, and data analytics, digital technologies can enhance operational performance, optimize energy production, and contribute to the broader goals of the water-energy nexus. However, despite these advantages, digitalizing HPPs—especially those integrated within drinking water infrastructure—comes with several challenges. Issues such as data collection and storage issues, operational challenges, cybersecurity risks, high implementation costs, data integration complexities, and the need for skilled personnel can hinder the effective adoption of digital solutions. Additionally, the variability of water flow and regulatory constraints further complicate digitalization efforts in these systems. Addressing these challenges requires strategic investments in secure digital infrastructure, interdisciplinary collaboration, and policy frameworks that support innovation while ensuring the resilience of both water and energy systems. As the global focus on sustainable resource management intensifies, overcoming digitalization barriers in hydropower recovery systems will be essential for maximizing the potential of renewable energy within the water sector.

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REFERENCES

[1] E. Quaranta, G. Aggidis, R. M. Boes, C. Comoglio, C. De Michele, E. Ritesh Patro, E. Georgievskaia, A. Harby, I. Kougias, S. Muntean, J. Pérez-Díaz, P. Romero-Gomez, M. Rosa-Clot, A. J. Schleiss, E. Vagnoni, M. Wirth and A. Pistocchi, “Assessing the energy potential of modernizing the European hydropower fleet,” Energy Conversion and Management, vol. 246, 2021.

[2] INTERNATIONAL ENERGY AGENCY, “Hydropower Special Market Report-Analysis and forecast to 2030,” IEA, 2021.

[3] H. I. Skjelbred, “Digitalization of hydropower,” SINTEF, [Online]. Available: https://www.sintef.no/en/expertise/sintef-energy-research/digitalization-of-hydropower/. [Accessed 30 09 2024].

[4] I. Kougias, G. Aggidis, F. Avellan, S. Deniz, U. Lundin, A. Moro, S. Muntean, D. Novara, J. I. Perez-Diaz, E. Quaranta, P. Schild and N. Theodossiou, “Analysis of emerging technologies in the hydropower sector,” Renewable and Sustainable Energy Reviews, 2019.

[5] M. Hamlehdar, H. Yousefi, Y. Noorollahi and M. Mohammadi, “Energy recovery from water distribution networks using micro,” Energy, 2022.

[6] M. Sinagra, E. Creaco, G. Morreale and T. Tucciarelli, “Energy recovery optimization by means of a turbine in a pressure regulation node of a real water network through a data-driven digital twin,” Research Square, 2023.

[7] C. Ion and C. Marinescu, “Autonomous micro hydro power plant with induction generator,” Renewable Energy, vol. 36, pp. 2259-2267, 2011.

[8] P. Baron, M. Kočiško, S. Hlavatá and E. Franas, “Vibrodiagnostics as a predictive maintenance tool in the operation of turbo generators of a small hydropower plant,” Advances in Mechanical Engineering, 2022.

[9] V. Sürme, R. Daneshfaraz, A. Kerim, H. Abbaszadeh and J. Abraham, “Investigation of Clean Energy Production in Drinking Water Networks,” Water Resources Management, vol. 38, pp. 2189-2208, 2024.

[10] C. Giudicianni, D. Mitrovic, W. Wu, G. Ferrarese, F. Pugliese and I. Fernández-García, “Energy recovery strategies in water distribution networks: literature review and future directions in the net-zero transition,” Urban Water Journal, pp. 1185-1200, 2023.

[11] Z. B. Karabay, “Anadolu Ajansı,” 26 06 2024. [Online]. Available: https://www.aa.com.tr/en/energy/hydro/turkiye-leads-europe-with-highest-rise-in-hydropower-capacity-last-year/42116. [Accessed 27 03 2025].

[12] C. Join, G. Robert and M. Fliess, “Model-Free Based Water Level Control”.

[13] A. Myint, K. Latt, T. Hla and N. Tun, “IoT-Based SCADA System Design and Generation Forecasting for Hydropower Station,” International Journal of Electrical and Electronic Engineering & Telecommunications, vol. 10, no. 4, 2021.

[14] A. Betti, E. Crisostomi, G. Paolinelli, A. Piazzi, F. Ruffini and M. Tucci, “Condition monitoring and early diagnostics methodologies for hydropower plants,” 2019.

[15] T. Welte and J. Foros, “Monitor X - Digitalization in Hydropower,” SINTEF, 2019.

[16] A. Åsnes, A. Willersrud, F. Kretz and L. Imsland, “Predictive maintenance and life cycle estimation of hydro power plants with real-time analytics,” 2018.

[17] K. He, T. Wang, F. Zhang and X. Jin, “Anomaly detection and early warning via a novel multiblock-based method with application to thermal power plants,” Meas. J. Int. Meas. Confed., vol. 193, p. 110979, 2022.

[18] B. Sambana, P. Appala Naidu, R. Jarabala and V. Narayana, “Performance validation of wind turbines using machine learning methodologies,” Mater. Today Proc., 2022.

[19] M. Sartor, L. Souza, A. Júnior, H. Rebelo, K. Cotta, L. Vianna, R. Pereira and M. Morais, “Assets Performance Management systems for hydroelectric power plants—A survey,” Electric Power Systems Research, vol. 228, 2024.

[20] R. Zemouri, S. Bernier, O. Kokoko and A. Merkhouf, “Hydro-generators fault diagnosis with short-time-wavelet-entropy and variational auto-encoder,” in IOP Conference Series: Materials Science and Engineering, 2021.

[21] P. Hudi and R. Shahsavari, “Comparative studies among machine learning models for performance estimation and health monitoring of thermal power plants,” Applied Energy, 2020.

[22] D. Kwon, M. R. Hodkiewicz, J. Fan, T. Shibutani and M. G. Pecht, “IoT-Based Prognostics and Systems Health Management for Industrial Applications,” IEEE Access, vol. 4, pp. 3659-3670, 2017.

[23] M. Schlechtingen, I. Santos and S. Achiche, “Wind turbine condition monitoring based on SCADA data using normal behavior models,” Applied Soft Computing Journal, vol. 12, pp. 259-270, 2013.

[24] E. Vagnoni, D. Gezer, I. Anagnostopoulos, G. Cavazzini, E. Dojuak, M. Hočevar and P. RUdolf, “The new role of sustainable hydropower in flexible energy systems and its,” Renewable Energy, vol. 230, no. 120832, 2024.

[25] O. Matania, L. Bachar, E. Bechhoefer and J. Bortman, “Signal Processing for the Condition-Based Maintenance of Rotating Machines via Vibration Analysis: A Tutorial,” Sensors, no. Sensors for Real-Time Condition Monitoring and Fault Diagnosis, 2024.

[26] J. Wang, L. G. R. X. Ye, C. Li and L. Zhang, “Digital Twin for rotating machinery fault diagnosis,” International Journal of Production Research, vol. 57:12, pp. 3920-3934, 2019.

[27] F. Gerini, E. Vagoni, R. Cherkaoui and M. Paolone, “Optimal CAM Computation of Kaplan Turbines Accounting for Wear and Tear Originated by Frequency Control,” in IEEE Madrid PowerTech, 2021.

[28] J. Schmid, S. Alligné, D. Biner, C. Münch-Alligné, N. Hugo and C. Nicolet, “Optimization of turbine start-up sequence of a full size frequency converter variable speed pump-turbine,” in IOP Conference Series: Earth and Environmental Science, Montreal, Canada, 2022.

[29] Grundfos, “grundfos.com,” [Online]. Available: https://www.grundfos.com/uk/learn/research-and-insights/identify-root-causes-effectively. [Accessed 27 03 2025].

[30] G. Butte, Y. T. Solano-Corea, M. V. Peppa, D. M. Ruíz-Ordóñez, R. Maysels, N. Tuqan, X. Polaine, C. Montoya-Pachongo, C. Walsh and T. Curtis, “A Framework for Water Security Data Gathering Strategies,” Water, vol. 14, no. 18, 2022.

[31] M. Liu, X. Wu and J. Zhang, “Hydropower recovery in urban water distribution systems: Challenges and opportunities,” Renewable Energy, vol. 171, pp. 1221-1234, 2021.

BIOGRAPHY

Mehmet Akif Bütüner is a Senior Researcher at TÜBİTAK Marmara Research Center (MRC), specializing in the digitalization and automation of renewable energy systems, particularly hydropower plants. He has extensive experience in the design, production, and commissioning of unit control, synchronization, protection, and governor systems for large-scale hydropower refurbishment projects. He holds an MSc in Electrical and Electronics Engineering from Ankara University and a BSc in Electrical and Electronics Engineering from Middle East Technical University (METU). Passionate about innovation and sustainability, Mehmet Akif aims to integrate traditional hydropower systems with intelligent, data-driven technologies to enhance efficiency, reliability, and grid flexibility across the renewable energy sector.

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Surya Kandukuri works as a Senior Researcher at NORCE, in the DARWIN research group. He obtained his master's degree in control engineering from TU Delft in 2006 and PhD in condition monitoring from the University of Agder in 2018. Since 2007, he has been working in condition monitoring across energy, aerospace, marine, and digitalization sectors with GE Global Research, Airbus Defense and Space, Machine Prognostics AS, and Cognite AS, respectively. Through his stint in the industry, he developed remote monitoring and diagnostics solutions for several high-value equipments such as gas turbines, steam turbine components, heat exchangers, gasification units, aircraft electrical systems, and marine vessel propulsion systems. His current research includes the development of condition monitoring for machinery and structures with applications in wind, hydropower, fish farming, and rail infrastructure.

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