FOREWORD BY THE EDITORIAL BOARD AND THE GUEST EDITOR

Dear Readers and Contributors,

We are pleased to present the latest issue of Elektroprivreda – *Electric Power Industry Journal*. As a continuation of the journal's partnership with the CIGRE Serbia National Committee, this is another special edition featuring extended and enhanced versions of six selected conference papers that received awards at the organisation's 37th National Conference, held in Zlatibor from 26 to 30 May 2025. Distinguished experts from academia and industry, specialising in the fields covered by these papers, served on the Guest Editorial Board, which, in collaboration with the journal's permanent Editorial Board, reviewed and peer-reviewed the manuscripts and prepared this issue for publication.

The first paper presents the technical solution, characteristics and functionalities of the new excitation systems for the motor-generators at the Bajina Bašta Pumped-Storage Hydropower Plant (PSHPP). The replacement of the legacy excitation systems was carried out as part of the recently completed refurbishment of the plant's generating units, a key undertaking for maintaining the stability of Serbia's power system and facilitating the integration of renewable energy sources. The newly installed state-of-the-art excitation controllers provide full control of the units under all operating conditions, with high reliability ensured by a redundant (1+1) architecture of the thyristor bridges and control units. The units are capable of operating in all four quadrants of the operating diagram and support both synchronous start-up and electrical braking. The paper concludes with illustrative dynamic response recordings obtained during the acceptance testing of the units, which were used to evaluate and verify the system's dynamic performance indicators.

The second paper begins with an overview of the key technological principles, advantages and limitations of modern green hydrogen production methods, with particular emphasis on electrolysis. It also highlights the technological trends driving the increasing adoption of hydrogen in energy systems. The authors then present a practical conceptual proposal for the construction of a hydrogen production and storage facility to provide a substitute fuel for the potential future gas turbines of Units A1 and A2 at the Nikola Tesla Thermal Power Plant. The proposed location benefits from an already established supporting infrastructure. The paper analyses the conditions required for the development of an integrated energy complex for hydrogen production, storage and utilisation, examines the associated challenges, and proposes suitable locations for water supply facilities, electrolysers, and hydrogen storage systems. As such, it offers a coherent assessment of one of the potential pathways towards the decarbonisation of Serbia's power sector.

Building on the theme of the development and application of hydrogen technologies, the next paper also addresses issues related to electrolyser operation. Specifically, it presents the development and practical implementation of specialised power converter topologies for supplying alkaline electrolysers used in the production of "green" hydrogen. Its particular value lies in the fact that it goes beyond theoretical analyses and simulation models, describing instead a fully realised 40 kW industrial installation that has been successfully commissioned within a thermal power generation system for generator cooling purposes. The innovative nature of this solution, developed by domestic experts, is reflected in a unique twelve-pulse topology that eliminates the need for an interphase reactor between the two thyristor bridges. Instead, a three-winding transformer with secondary voltages of unequal amplitudes is employed. The paper is richly illustrated with diagrams and experimental results that confirm the theoretical principles presented.

The following paper is likewise devoted to the field of power electronics. It examines the modelling of dynamic losses in gallium nitride (GaN) power switches, a modern wide-bandgap semiconductor technology used to achieve high efficiency and high-power density. Unlike existing approaches reported in the literature, the proposed analytical model simultaneously accounts for the nonlinear dependence of the parasitic capacitances (Ciss, Coss and Crss) on the drain-source voltage, as well as the nonlinear variation of the GaN switch transconductance (gm). An algorithm is defined and implemented to discretise the nonlinear characteristic curves provided in manufacturers' datasheets into more than 100 points, thereby avoiding the analytical approximations that introduce errors at high switching frequencies. The key innovation is the detailed mathematical separation of the total current into channel conduction current and parasitic capacitance current. This distinction enables the precise identification of losses during hard-switching, soft-switching and quasi-soft-switching commutation processes in a half-bridge configuration. The paper also has significant practical value, as the proposed theoretical model was validated using a 1 kW synchronous buck converter prototype designed and built by the authors themselves, who conducted measurements across its entire operating voltage range.

The penultimate paper describes a controlled switching technique as a means of limiting the adverse effects of switching transients. This is a highly topical issue in modern transmission systems. The controlled switching function and its potential benefits within a transmission network were tested under laboratory conditions. The experimental setup consisted of a microprocessor-based protection and control device acting as the controller, together with a real-time Hardware-in-the-Loop (HIL) simulator on which a model of a 400 kV shunt reactor and a circuit breaker was implemented. The effects of switching transients associated with the energisation of different types of loads are presented, and a comparison is made with the conventional switching of a shunt reactor circuit breaker. The laboratory validation of the results adds significant practical value to the conclusions presented in the paper.

The final paper examines the implementation of the European regulatory framework and operational practices within the work of transmission system operators (TSOs) in the Western Balkans region. It outlines the coordination of processes carried out at the level of European transmission system operators and the principal changes being introduced into the operational activities of Serbia's TSO, Elektromreža Srbije (EMS JSC). The two most important processes, coordinated security analysis and transmission capacity calculation, are being aligned with the requirements of ENTSO-E. The paper also presents the regulatory process through which EMS JSC is joining the European capacity calculation regions, namely the CORE and SEE regions, and highlights the challenges associated with this integration. The fundamental concepts of the coordinated processes are explained, some of which will be implemented directly by the TSO, while others will be carried out through regional coordination centres. In this context, compliance with the requirement to make available 70% of the capacity of critical network elements, particularly interconnecting transmission lines, is essential. This requirement also applies to the management of internal transmission line loading affecting cross-border interconnections within the broader congestion management process in the South-East European interconnection and the Serbian transmission network. The particular value of this paper lies in its clear presentation of the current European landscape in comparison with Serbia's position and degree of implementation, as well as in its identification of the processes and activities that must be undertaken in the coming period. The implementation of the mechanisms analysed is one of the key prerequisites for Serbia's integration into the single European electricity market, including participation in day-ahead and intraday market coupling, as well as accession to the European balancing platforms.

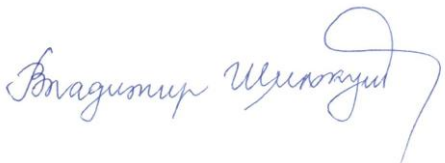
In view of the timeliness of the topics addressed and the innovative nature of the solutions presented in these papers, we are confident that the content of this issue will capture your interest and prove valuable to your work. Most of the articles focus on power electronics, a field to which the late Professor Vladimir Katić, former Chairman of the journal's permanent Editorial Board, made an outstanding contribution. In addition to a tribute reviewing his remarkable career and lasting impact on both the profession and the scientific community, this issue concludes with an Excerpt from his extensive bibliography. We hope that the titles collected in this selection will serve as a useful resource for experts working in the fields to which Professor Katić devoted his research, thereby further enhancing the accessibility and value of his scientific and professional legacy.

We would also like to take this opportunity to renew our invitation to readers to participate actively in the life of the Journal. We warmly encourage you to submit manuscripts of scholarly and professional articles, as well as discussions, commentaries, polemics, or personal viewpoints relating to previously published papers and to the specific technical and scientific issues they address. We will be pleased to consider all materials received and to explore opportunities for their publication in future issues of the Journal.

On behalf of the Guest Editorial Board
of this Special Issue of the Journal,

Nebojša Petrović, Dipl. El. Ing.
President of CIGRE Serbia
Guest Editor-in-Chief

On behalf of the Journal Editorial Board,



Dr Vladimir Šiljkut, Dipl. El. Ing.
Editor-in-Chief and Responsible Editor