

UDC: 621.314.52(497.11)

Dušan Joksimović<sup>1</sup>, Đorđe Stojić<sup>1</sup>, Nemanja Milojčić<sup>1</sup>, Zoran Ćirić<sup>1</sup>,  
Slavko Veinović<sup>1</sup>, Luka Ivanović<sup>1</sup>, Ilija Klasnić<sup>1</sup>, Miroslav Pavićević<sup>2</sup>, Dušan Trišić<sup>2</sup>



## Design and Dynamic Performance of Redundant Excitation Systems for Motor-Generators at Bajina Basta Pumped-Storage Hydro Power Plant

<sup>1</sup> Nikola Tesla Institute of Electrical Engineering JSC Belgrade, Serbia

<sup>2</sup> EPS JSC, Branch Drinsko-Limske HPPs, HPP Bajina Bašta, Serbia

Professional article

### Highlights

- Revitalization of the units at PSHPP "Bajina Bašta" – crucial for system stability and the integration of renewable energy sources.
- Modern excitation regulators enable complete control of the units in all operating states, with high reliability ensured by a redundant (1+1) architecture of thyristor bridges and control units.
- Support for unit operation in all four quadrants of the capability diagram, including synchronous start and electrical breaking.

### Abstract

The run-of-river and pumped-storage hydro power plants (PSHPP) "Bajina Bašta" in Perućac represent the largest hydroelectric facilities built on the Drina River. PSHPP "Bajina Bašta" is of immense importance to the Serbian power system due to its ability to operate in both generator and motor modes, which increases system flexibility in terms of production and consumption management. Additionally, due to its capability for rapid startup and quick transitions between generator and motor modes, this plant can react swiftly to system disturbances and replace any other unit within the "Elektroprivreda Srbije" system. Consequently, the revitalization of PSHPP "Bajina Bašta," aimed at extending the units' lifespan for several decades, is of great significance to the power system. During 2024, the first unit was revitalized, while the revitalization of the second unit was completed in 2026. As part of the revitalization, the entire excitation systems were replaced. High-performance components were installed within the power section of the excitation system: excitation transformers, circuit breakers, thyristor bridges, de-excitation equipment, etc. The core of the control section consists of certified digital excitation regulators, which feature integrated sequential automation for all operating modes: generator mode, motor mode, synchronous start, and electrical braking. The regulators enable various control modes: automatic stator voltage regulation, reactive power regulation, or power factor regulation, along with integrated limiter functions and a power system stabilizer. System reliability is further ensured by the redundant implementation of thyristor bridges and excitation regulators in a 1+1 configuration. Following the completion of installation and connection of all equipment, detailed tuning and testing of the excitation system were conducted, demonstrating high system performance. This guarantees reliable and stable operation of the units in all intended modes, with automatic operation limiting within the defined boundaries of the capability diagram.

### Keywords

Excitation system, Motor-generator, Reliability, Revitalization

#### Notes:

The full text of this article is available only in the Serbian language.  
In the English version, only its Abstract (above) is available.

This article represents an expanded, improved and additionally peer-reviewed version of the paper "Excitation Systems for Motor-Generators in the Bajina Bašta Pumped-Storage Hydropower Plant" (<https://doi.org/10.2478/epi-journal-eps-2025-00018>), awarded in the Expert Committee EC-A1 Electrical Machines, at the 37<sup>th</sup> CIGRE Serbia Conference, Zlatibor, 26-30 May 2025.

Received: April 6<sup>th</sup>, 2026

Reviewed: June 30<sup>th</sup>, 2026

Modified: July 9<sup>th</sup>, 2026

Accepted: July 14<sup>th</sup>, 2026

\*Corresponding author: Dušan Joksimović, +381 64/82-59-741

E - mail: [dušan.joksimovic@icent.org](mailto:dušan.joksimovic@icent.org)