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## *Advanced Hydro Generation Systems*

By

***Luis Rouco***

Universidad Pontificia Comillas  
Madrid, Spain

### **Abstract**

Decarbonizing the economy to fulfill the Paris Agreement goals requires the development of vast amounts of renewable power generation. The feasible integration of wind and solar photovoltaic power generation in the power system requires resources to address their intermediacy. Three complementary resources must be used: storage, interconnections, and demand management. The Spanish Integrated Plan on Energy and Climate estimates 18 GW of storage in 2030 [1]. Despite the developments in battery energy storage systems, their economic feasibility is not assured. In contrast, several hydro-pumped storage projects (greenfield and brownfield [2]) are currently being considered in Spain.

The competitiveness of hydro-pumped storage projects is greatly affected by the turbine and pump efficiency under a wide range of heads. It may be at risk if a constant speed drive is considered. An alternative to a constant-speed drive is a variable-speed one [3].

This contribution will describe an advanced hydro generation system based on variable speed drive. The role of such a system in a complex river system will be detailed. The hydraulic machine-generator set controls in interconnected system and island modes will be provided [4]. Mathematical models of such control systems will be described.

### **References**

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## *Short biography of Prof. Dr. Luis Rouco Rodríguez*



**Address:** Escuela Técnica Superior de Ingeniería ICAI  
C/ Alberto Aguilera, 25. 28015 Madrid

**Primary Email:** [rouco@comillas.edu](mailto:rouco@comillas.edu)

**Additional Email:**

**Web page:**

**Phone Number:** +34 915422800

**Mobile:** +34 650850060

**Luis Rouco** obtained his MSc and PhD degrees in Electrical Engineering from the Polytechnic University of Madrid in 1985 and 1990 respectively. He is Full Professor of Electrical Engineering in the School of Engineering of Universidad Pontificia Comillas.

He is the Director of the Course on Power System Operation jointly developed by Universidad Pontificia Comillas and Red Electrica de España. He has also served as Head of the Department of Electrical Engineering from 1999 through 2005.

Prof. Rouco teaches undergraduate courses on Electrical Machines and Power System Protection and graduate course on Electric Power Systems.

Prof. Rouco develops his research activities at Instituto de Investigación Tecnológica (IIT). His areas of expertise are modelling, simulation, simulation, control and identification of electric power systems where he has led more than 250 research projects for Spanish public administrations, Spanish electric utilities and other Spanish engineering and industrial companies. He has also developed research projects for foreign companies and institutions. Prof. Rouco has published more than 200 papers in international journals and conferences. Prof. Rouco is Senior Member of IEEE and Distinguished Member of Cigré.

He is president of the Electric Energy Systems-University Enterprise Training Partnership (EES-UETP), Member of the Executive Committee of the Spanish National Committee of CIGRE, Convener of the Advisory Group A1.5 New Technologies of the Study Committee A1 Rotating Machines of CIGRE, editor of IEEE Transactions on Power Systems, member of the Technical Program Committee of Power Systems Computation Conference (PSCC) and Technical Program Chair of the IEEE PowerTech Madrid 2021. Stanford University has included him in the 2% of the most cited scientists in the world since 2021.

He has been visiting scientist at Ontario Hydro (Toronto, Canada), MIT (Cambridge, Massachusetts, USA) y ABB Power Systems (Vasteras, Sweden).