



## **Grid access of non-synchronous generation: Review of the Spanish regulation**

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### **Abstract**

Decarbonization of the economy to fulfill the Paris agreement goals requires the development of huge amounts of renewable power generation. Wind and solar photovoltaic power generation technologies have become technically mature and economically competitive technologies. Wind and solar photovoltaic generation are connected to the grid through power electronic converters. It results in formidable challenges for power system stability, control and protection. Due to such fact, it can be stated that ac power systems are facing the largest transformation since Edison, Tesla and Westinghouse.

The development of wind and solar photovoltaic generation depends critically on the access to the grid. In contrast to synchronous generation, the access to the grid of converter based generation (also called non-synchronous generation) is affected by a number of technical constraints.

The Spanish regulation of the grid access of non-synchronous generation has been recently reformulated.

This contribution will review the new regulation [1]. The former regulation will be also discussed ([2], [3]). The former regulation was based exclusively on the Short Circuit Ratio criterion [4]. The new regulation is based on the Weighted Short Circuit criterion [5] together with steady-state and dynamic security assessments.

### **References**

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- [2] Orden de 5 de septiembre de 1985 por la que se establecen normas administrativas y técnicas para funcionamiento y conexión a las redes eléctricas de centrales hidroeléctricas de hasta 5.000 kVA y centrales de autogeneración eléctrica (B.O.E. No. 219, 12 septiembre 1985, páginas 28810 a 28814).
- [3] Real Decreto 413/2914, de 6 de junio por el que se regula la actividad de producción de energía eléctrica a partir de fuentes de energía renovables, cogeneración y residuos, B.O.E. núm. 140, de 10 de junio de 2014, páginas 43876 a 43978.
- [4] IEEE, IEEE Guide for Planning DC Links Terminating at AC Locations Having Low Short-Circuit Capacities, IEEE Std. 1204-1997, 1997.
- [5] NERC, Integrating Inverter-Based Resources into Low Short Circuit Strength Systems. Reliability Guideline, December 2017,

## Short biography of Prof. Luis Rouco Rodríguez



Luis Rouco Rodríguez obtained the titles of Industrial Engineer and Doctor Industrial Engineer for the Technical University of Madrid in 1985 and 1990 respectively. He is a Professor of the Technical School of Engineering (ICAI) of the University Pontificia Comillas of Madrid. He has been The Director of the Department of Electrotechnics and Systems in the period 1999-2005. It teaches courses of Electrical Machines in the studies of Industrial Engineer and of Advanced Analysis of Systems of Electric power and of System stability of Electric power in the Program of Postdegree in Electric power School.

He has been The Director of the Specialist's Course in Operation of the Electrical System REE-ICAI in the period 2004-2007 and of the Master in Electrical Technology ENDESA-ICAI in the period 2007-2011. Prof. Rouco Rodríguez develops his activities of research in the Institute of Technological Research (IIT) where it has supervised numerous projects of research and consultancy for the public Spanish administrations (Department of Education, Department of Promotion, GIF, etc.), the principal electrical Spanish companies like Endesa, Iberdrola, Natural Gas, Electrical Network of Spain, Union Fenosa and Viesgo and other industrial companies as ABB, Iberian AEG of Electricity, Ardanuy Ingeniería, Babcock and Wilcox Española, Hard Felguera, Eliop, Grouped Businessmen, Indra, Initec Energía, To hoist, SEMI, Sener and Assembled Technologies. Also it has developed projects for companies and foreign institutions as Alstom (Switzerland), University of La Plata and CAMMESA (Argentina), RTE-France and INESC - I Carry (Portugal). The areas of work of the Prof. Rouco Rodríguez are the shaped one, analysis, simulation and control of the systems of electric power.

Prof. Rouco Rodríguez has published great number of articles in conferences and national and foreign magazines. Prof. Rouco Rodríguez is member of the IEEE and of CIGRÉ, President of the Spanish Chapter of the Power and Energy Society of the IEEE and member of the Executive Committee of the National Committee of CIGRÉ's Spain. He has been an investigative visitor in Ontario Hydro (Toronto, Canada), MIT (Cambridge, Massachusetts, The United States) and ABB Power Systems (Vasteras, Sweden).