Towards resilient net-zero power systems

LECTURE ABSTRACT

Due to the evident climate change and environmental pressures the future power/energy systems will have to operate, sooner rather than later, in a net-zero environment, i.e., any carbon emissions created will have to be balanced (cancelled out) by taking the same amount of carbon out of the atmosphere, so that the amount of carbon emissions added to the atmosphere should not be more than the amount taken away. This will manifest in: by mix, at least during the transition period, of wide range of electricity generating technologies including conventional hydro, reducing but still present thermal, possibly increasing nuclear and even higher and accelerated connection of power electronic interfaced stochastic and intermittent renewable generation; blurred boundaries between transmission and distribution system; responsive and highly flexible, typically power electronics interfaced, demand and storage technologies with significant temporal and spatial uncertainty; proliferation of power electronics (HVDC, FACTS devices and new types of load devices); significantly higher reliance on the use of legacy and measurement data including global (Wide Area Monitoring) signals for system identification, characterization and control and Information and Communication Technology embedded within the power system network and its components; and ever increasing emphasis on considering the "whole system", not only comprising different energy vectors, but also ICT, traffic, water and social systems, to ensure energy supply security and efficiency. The key characteristics of such a complex system, if only a few are to be picked, would certainly be proliferation of power electronic devices in different shapes and forms and for different purposes, increased uncertainties in system operation and parameters and much largerer reliance on the use of measurement and other data collected. This will increase controllability and observability of the system but may as a trade off result in different/unexpected dynamic behaviour of the system and possibly, under some circumstances, deterioration of some aspects of its performance.

This presentation first briefly introduces some of the key characteristics of future net-zero power systems, then identifies the key challenges associated with ensuring resilience (the ability to withstand low-frequency high-impact incidents efficiently while ensuring the least possible interruption in the supply of electricity) of such systems and finally discusses examples of the latest research results in the areas of probabilistic stability studies of uncertain systems, data analytics, risk assessment and complex system analysis, which all are essential constituent parts of comprehensive assessment of power system resilience.

BRIEF BIO

Jovica V Milanović received Dipl.Ing. and M.Sc. degrees from the University of Belgrade, Yugoslavia, Ph.D. degree from the University of Newcastle, Australia, and D.Sc. degree from The University of Manchester, UK. Prior to joining The University of Manchester, UK, in 1998, he worked with "Energoproject", Engineering and Consulting Co. and the University of Belgrade in Yugoslavia, and the Universities of Newcastle and Tasmania in Australia.

Currently, he is a Professor of Electrical Power Engineering and Deputy Head of Department of Electrical and Electronic Engineering at The University of Manchester, UK, and Visiting Professor at the University of Novi Sad and the University of Belgrade, Serbia. He was chairman of 5 international conferences, editor or member of editorial/technical boards of 70+ international journals and conferences, research project assessor or panel member for numerous international government research funding councils, member of 9 (convenor of 3) past or current IEEE/CIGRE/CIRED WG and consultant or member of advisory boards for several international companies. Professor Milanovic participated in or lead numerous research projects with total value of more than £80 million, published close to 600 research papers and reports, gave about 30 key-note speeches at international conferences and presented about 150 courses/tutorials and lectures to industry and academia around the world. Professor Milanovic is a Chartered Engineer in the UK, Foreign member of the Serbian Academy of Engineering Sciences, Fellow of the IET, Fellow of the IEEE, Distinguished IEEE PES Lecturer, Member and past-Chair of the IEEE Herman Halperin Transmission and Distribution Award Committee, Associate Editor of IEEE Transactions on Power systems and Power Engineeering Letters and a member of IEEE PES Industry Technical Support Leadership Committee. He was a member of the IEEE PES Governing Board as Regional Representative for Europe, Middle East and Africa for six years and a member and vice-chair of IEEE PES Fellows Evaluation Committee. From January 2022 Professor Milanovic will be Editor-in-Chief of IEEE Transactions on Power Systems.

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