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«Reliability and Resilience in Low-carbon, Low-inertia Power Systems: New concepts, models, assessment frameworks, and experiences from the September 2016 "Black System" event in South Australia»

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Room 010, Building 07

Abstract:

Our understanding of the classical reliability concepts of security and adequacy is increasingly being challenged by: (a) growing shares of variable renewable energy sources that require new system operation approaches, particularly to deal with decreasing levels of inertia and larger balancing and reserve requirements; and (b) the more frequent occurrence of extreme events (for instance driven by climate change) with potentially catastrophic impacts. There then may be situations when these two challenges occur simultaneously, such as in the September 2016 South Australia "Black System" event.

The primary aim of this *IEEE PES Distinguished Lecture* is to discuss how, based on both technical and economic considerations, there is a need for introducing new analysis and modelling frameworks that are capable to securely deal with low-inertia system operation and make future low-carbon power systems more resilient to high-impact, low-probability events. The key desirable features of such frameworks will be presented, alongside a suite of modelling tools recently developed and relevant metrics that can support assessing risk and resilience of future systems.

The key question that will then be asked is whether the system should be made "bigger" (e.g., making the system more redundant or robust, through investment into new transmission and generation asset, component hardening, etc.) or "smarter". Consideration for the latter will include analyzing the role of new operational strategies (e.g., frequency response-constrained optimal power flow, dynamic scheduling of the largest contingency, controlled islanding, etc.) as well as of smart grid technologies (e.g., Fast Frequency Response from various sources, system integrity protection schemes, etc.).

The South Australia "Black System" event of September 2016 (and its consequences) will be taken as a case study to illustrate some of the general concepts presented, with particular focus on new security requirements (particularly for regional minimum inertia, frequency response and voltage stability) that could also help in dealing with extreme events in low-inertia power systems. Analogies between Australian and Cyprus in the context of increasing shares of renewables will also be drawn.

Key recommendations to make future low-carbon, low-inertia power systems more reliable and resilient will finally be provided.

Biography:

Pierluigi Mancarella is Chair Professor of Electrical Power Systems at The University of Melbourne, Australia, and part-time Professor of Smart Energy Systems at The University of Manchester, UK.

Pierluigi obtained the PhD degree in Electrical Energy Systems from the Politecnico di Torino, Italy, has been a Research Associate at Imperial College London, UK, and has held visiting research positions at Sintef/NTNU in Norway and at NREL in Colorado, as well as visiting professorships at Ecole Centrale de Lille in France and at the Universidad de Chile.

Pierluigi has been involved in/led, in the last 10 years, some 50 research projects and consultancy and professional activities in the UK, Europe, Australia, and internationally, in the area of techno-economics of smart grid technologies and distributed energy systems, risk and resilience assessment of future networks, integrated multi-energy systems modelling, and energy infrastructure investment under uncertainty. He has also recently led the “Power system security assessment of the future National Electricity Market” work for the Australian Federal Government’s Independent Review into the Future Security of the National Electricity Market (“Finkel Review”).

Pierluigi is author/editor of four books, several book chapters, and over 250 research papers and reports. He is an Editor of the IEEE Transactions on Smart Grid, of the IEEE Systems Journal, and of the International Journal of Electrical Power and Energy Systems, as well as Guest Editor of the Philosophical Transactions of the Royal Society A.

Pierluigi is an IEEE Power and Energy Society Distinguished Lecturer, and the past Chair of the Energy Working Group of the IEEE European Public Policy Initiative.