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Tutorial – 4

Theme: Micro-grids

Solution to the future power distribution: Microgrids

By

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Abstract

With every increasing load demand across the world we have to keep on adding generation into our system to balance the energy required. In that process, we have kept on adding coal fired thermal generation that lead to huge amount of carbon footprints. Thus, in the current era the whole world is looking for green and clean energy and that is possible by integrating natural based renewable generation in specific PV and wind generation. These renewables can be integrated to our existing system so that the pollution level can come down and we can achieve low carbon foot print across the globe. In India around 65% of the total energy generated are from the coal plants, and only 5-7% of the energy is currently generated by the renewable. In 2012 peak summer, India had to experience a serious blackout where entire country was under dark for three days except southern part of the country. This led to lot of socio-economic problems in the life of people across the nation. The reason for this was increase in demand and cascaded failure of generators to supply for the need. In spite of understanding the importance of renewable, it is not possible to have large scale integration of renewable to the main grid due to the geographical and transmission line limitations. Thus, the concept of microgrid has gained lot of interest in recent days. Microgrids are local grids formed at the distribution level with local renewable to supply for the local demand, these small cluster of grids will reduce the over dependence/stress on the main grid and also increases the reliability of the customers even if the main grid fails. Though the major part of the generators/loads works in the AC platform, the increase in use of computer loads/electronic gadgets and power generated by the photovoltaics (PV) works at DC. Hence, there is a need of AC and DC microgrids to separate out the AC/DC sources/loads and thereby overall efficiency of the system can be improved. These microgrids when added with the communication technology can really make the world's electricity to work

in a smart way. This allows the end users to take part in demand side management/demand response (DSM/DR)/energy management techniques thereby reducing peak loading on the grid, reduction in system losses, self-healing of the system etc.

With the above understanding, this tutorial is structured in such a way that it gives basic understating on the different smart grid components, architecture, standards and policies of the smart grid. Operation and control of AC, DC and hybrid microgrid system is also emphasized. Further, key smart grid research components like DSM, DR, Energy management and load flow analysis are discussed with the suitable examples. Apart from these various case studies of the smart grid research activities which are carried out at the IIT Roorkee smart grid research laboratory are also shared in the tutorial.

Biography

Dr. Narayana Prasad Padhy, born on 31st August 1969 in Berhampur(Orissa), India and received his Degree in Electrical Engineering, Masters (Power Systems Engineering) with Distinction and Ph.D.,(Power Systems Engineering, Guindy engineering college, Anna University, Chennai, India) in the year 1990, 1993 and 1997 respectively. Immediately after Ph.D., he joined the Department of Electrical Engineering, Birla Institute of Technology and Sciences (BITS), Pilani, India, as an Assistant Professor and worked till July 1998. Then he joined the Department of Electrical Engineering, University of Roorkee and now Indian Institute of Technology (IIT) Roorkee, India, as a Lecturer, Assistant Professor, Associate Professor and Professor during July 1998, Feb. 2001, Feb. 2006 and April 2008 respectively. During 2005-2006 he has visited the Department of Electronics and Electrical Engineering, University of Bath, UK under Better Opportunities for Young Scientists in Chosen Areas of Science & Technology (BOYSCAST) Fellowship Scheme of Ministry of Science and Technology, Govt. of India. During 2009-2010 he has visited the Department of Electrical and Computer Engineering, Ryerson University, Toronto, Ontario, Canada. He has also been awarded **"**Humboldt Research Fellowship for Experienced Researchers**"** by Alexander von Humboldt Foundation, Germany in the year 2009 to carry out research in the area of renewable generations at University Duisburg Essen, Germany. He has profound research experience in power systems and Smart grid and he is lead Principal Investigator in DST funded Indo-UK Smart Energy Grids and Energy Storage technologies project titled "High Energy and Power Density(HEAPD) Solutions to Large Energy Deficits" with a funding of Rs.2.33 Crore, and Demonstration of MW-scale Solar Integration in weak grids using Distributed Energy Storage architecture (D-SIDES) with a funding of Rs. 3.5 crores under Mission Innovation Challenge on smart grids. He is a Co-Principal Investigator in DST sponsored U.S.-India collaborative for smart distribution System with Storage (UI-

ASSIST) with a funding resource of Rs. 4 Crores, Zero peak Energy building Design for India under UK India Reducing Energy Demand in the Built Environment with a funding of Rs. 1 crore and MHRD/MNRE sponsored e-PV Diesel generator with funding worth Rs. 25 Lakhs.

He has handled 20 sponsored research grant projects and contracts that includes Office of Gas and Electricity Market (OFGEM), UK in the area of Distribution Network Pricing with Wind Generations. He has delivered more than 100 invited guest lectures and attended 25 international academic/regulator's meeting. He has published (single author) a text book titled '*Artificial Intelligence and Intelligent Systems***'** with Oxford University Press in 2005, Prepared the SI Version of the text book and solution manual for Cengage Learning Publishing Company titled Power Systems Analysis and Design by Glover, J. Duncan , Sarma, Mulukutla S. , Overbye, Thomas. in 2009 and a text book titled 'Soft Computing with MATLAB Programming' with 'Oxford University *Press***'** in 2015. He has 23 Ph.D., 62 M.Tech guidance and 100 International Journals to his credit. Currently he is a full time Professor, Dean of Academic Affairs, Institute Chair Professor and also worked as Professor in Charge Training and Placement at IIT Roorkee and NEEPCO Chair Professor. He has been nominated both as a Fellow of Indian National Academy of India (FNAE) and Fellow of The Institution of Engineering and Technology, UK (FIET).

He is also representing India as a national lead in Mission Innovation Challenges #1 on Smart Grid and is also handling a resource center on Mission Innovation challenge on Smart grids at IIT Roorkee funded by DST, India.

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