



Practical Power Flow Controller Brings Benefits Of Power Electronics To The Grid

Presenter: Kalyan K. Sen, PhD, PE, MBA
IEEE PES Distinguished Lecturer

Date: 7 December, 2017, Thursday

Time: 5.30 PM

Venue: Transpower, Waikoukou Building, 22 Boulcott Street, Wellington

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Abstract: Power flow control techniques have been practiced, from using inductors, capacitors, transformers and load tap changers in the earlier days of electrical engineering to power electronics-based solutions in recent years. Even though the costs and complexities of the available solutions vary widely, the basic underlying theory of power flow control is still the same as it always has been. The question is which solution one should employ. The answer depends on knowing what the true need is. The power industry's pressing need for the most economical ways to transfer bulk power along a desired path may be met by building new transmission lines, which is a long and costly process. Alternately, it may be quicker and cheaper to utilize the existing transmission lines more efficiently. The key is to identify the underutilized transmission lines and harness their dormant capacity to increase the power flows to the lines' thermal limits.

Since the commissioning of the first commercial power electronics-based *Flexible Alternating Current Transmission Systems* (FACTS) controller two decades ago, a great deal has been learned about the true needs of a utility for its everyday use and they are high reliability, high efficiency, low installation and operating costs, component non-obsolescence, fast enough response for utility applications, high power density, interoperability, and easy relocation to adapt to changing power system's needs while providing the optimal power flow control capability. This was the motivation to develop a *SMART Power Flow Controller* (SPFC) that enhances the controllability in an electric power transmission system by using functional requirements and cost-effective solutions.

The presentation is designed to provide the basic principles of power flow control theory, an overview of the most commonly used power flow controllers, and future trends. The presentation will be of particular interest to all utility power engineering professionals. The required background is an equivalent of an Electrical Engineering degree with familiarity in power engineering terminology. The audience will hear from an expert who actually designed and commissioned a number of power electronics-based FACTS controllers since its inception in the 1990s.



Speaker: Kalyan Sen, a newly selected Fulbright Scholar, is the Chief Technology Officer of Sen Engineering Solutions, Inc. that specializes in

developing SMART power flow controllers—a functional requirements-based and cost-effective solution. He spent 30 years in academia and industry and became a Westinghouse Fellow Engineer. He was a key member of the Flexible Alternating Current Transmission Systems (FACTS) development team at the Westinghouse Science & Technology Center in Pittsburgh. He contributed in all aspects (conception, simulation, design, and commissioning) of FACTS projects at Westinghouse. He conceived some of the basic concepts in FACTS technology. He has authored or coauthored more than 25 peer-reviewed publications, 8 issued patents, a book and 4 book chapters in the areas of FACTS and power electronics. He is the coauthor of the book titled, *Introduction to FACTS Controllers: Theory, Modeling, and Applications*, IEEE Press and John Wiley & Sons, Inc. 2009, which is also published in Chinese and Indian paperback editions. He is the co-inventor of Sen Transformer. He received BEE, MSEE, and PhD degrees, all in Electrical Engineering, from Jadavpur University, India, Tuskegee University, USA, and Worcester Polytechnic Institute, USA, respectively. He also received an MBA from Robert Morris University, USA. He is a licensed Professional Engineer in the Commonwealth of Pennsylvania. He is a Distinguished Toastmaster who led District 13 of Toastmasters International as its Governor to be the 10th-ranking District in the world in 2007-8.

Kalyan, a Senior Member of IEEE, has served the organization in many positions. Under his leadership, IEEE Pittsburgh Section and its three chapters (PES, IAS and PELS) received Best Section and Chapter Awards. His other past positions included Editor of the *IEEE Transactions on Power Delivery* (2002 – 2007), Technical Program Chair of the 2008 PES General Meeting in Pittsburgh, Chapters and Sections Activities Track Chair of the 2008 IEEE Sections Congress in Quebec City, Canada, PES R2 Representative (2010 and 2011) and Member of the IEEE Center for Leadership Excellence (CLE) Committee (2013, 2014). He has been serving as an IEEE PES Distinguished Lecturer since 2002. In that capacity, he has given presentations on power flow control technology more than 100 times in 15 countries. He is an inaugural class (2013) graduate of the IEEE CLE Volunteer Leadership Training (VOLT) program. Kalyan is the recipient of the IEEE Pittsburgh Section PES Outstanding Engineer Award (2004) and Outstanding Volunteer Service Award for reviving the local Chapters of PES and IAS from inactivity to world-class performance (2004). He has been serving as the Special Events Coordinator of the IEEE Pittsburgh Section for the last decade. He is the Region 1-3 Coordinator of Power Electronics Society. For more details, click on

https://www.ieee-pes.org/images/files/pdf/chapters/archive/April2009_Chapters_Sen_PES_Volunteer.pdf

Recent publications:

- K. K. Sen, M. L. Sen, “Phase Angle Regulation Versus Impedance Regulation: Which Offers Greater Control Of Power Flow On the Grid?,” *How2Power Today e-magazine*, February, 2017.
http://www.how2power.com/newsletters/1702/articles/H2PToday1702_design_Sen.pdf?NOREDİR=1
- K. K. Sen, M. L. Sen, “Unique Capabilities of Sen Transformer: a Power Flow Regulating Transformer,” *IEEE Power & Energy Society General Meeting*, paper no. 16PESGM0961, July 2016, Boston, USA.
- K. K. Sen, M. L. Sen, “Comparison of Operational Characteristics between the Sen Transformer and Phase Angle Regulator,” *IEEE Power & Energy Society General Meeting*, paper no. 16PESGM0959, July 2016, Boston, USA.
- K. K. Sen, “Overview Of Voltage Regulation Schemes For Utility And Industrial Applications,” *How2Power Today e-magazine*, September, 2015.
http://www.how2power.com/newsletters/1509/articles/H2PToday1509_design_Sen.pdf?NOREDİR=1

- K. K. Sen, "Practical Power Flow Controller Brings Benefits of Power Electronics to the Grid," How2Power Today e-magazine, March, 2015.