**Southern Alberta Section**
**IAS-PES Chapter**

# SMART Power Flow Controller for Smart Grid Applications

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IEEE PES Distinguished Lecturer

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## Tutorial Abstract:

Power flow control techniques have been practiced, from using inductors, capacitors, and breakers in earlier days of Electrical Engineering to power electronics-based solutions in recent years. 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 learnt about the true needs of a utility for its everyday use and they are low installation and operating costs, component non-obsolescence, and easy relocation to adapt to changing power system's needs. This was the motivation to develop a SMART Power Flow Controller (SPFC) whose objectives are specific (design a power flow controller that meets utilities' needs), measurable (high reliability, high efficiency, cost-effective, component non-obsolescence, and portability), attainable (demonstrated theory by Westinghouse), relevant (efficient power grid), and timely (contemporary).

Utilities that are looking for ways to enhance the controllability in an electric power transmission system by voltage regulation, phase angle regulation, line impedance regulation, fault-current limitation, and much more should consider using a SPFC that uses functional requirements and cost-effective solutions. Even though the costs of the available solutions range from $10/kVA to $100/kVA, the basic underlying theory of power flow control is still the same as it always has been.

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 tutorial is organized in the following way:

- Part 1 (1.5 hours): A high-level overview of various power flow controllers and their features.
- Part 2 (1.5 hours): Traditional power flow controllers – voltage regulating transformer, phase angle regulator, shunt inductor/capacitor, and series inductor/capacitor; Voltage-Sourced Converter (VSC).
- Part 3 (1.5 hours): VSC – 6-pulse, 12-pulse, 24-pulse, and 48-pulse harmonic neutralized VSCs.
- Part 4 (1.5 hours): Modeling and implementation of the VSC-based technology, comparison of theory, simulation, and field results; special applications of VSC-based technology; Sen Transformer.

**Location:** The Carriage House Inn
Victoria Room

9030 Macleod Trail South
Calgary, Alberta

**Date:** Thursday, February 19, 2015

**Time:** 7:30AM to 4:00PM (8.5 hours) All times are: Canada/Mountain

Breakfast and Lunch are included.

**Register at:** https://meetings.vtools.ieee.org/m/31337

**Speaker:**

Kalyan Sen

Kalyan Sen is the Chief Technology Officer of Sen Engineering Solutions, Inc. (www.sentransformer.com) that specializes in developing SMART power flow controllers. He spent 28 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, USA. 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 more than 25 patents and publications 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. 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.

Kalyan, a Senior Member of IEEE, has served the organization in many positions. In 2003, he reestablished the Pittsburgh Chapters of the Power & Energy Society and the Industry Applications Society. Both Chapters received the “Outstanding Large Chapter” awards for their activities in 2004. Under his Chairmanship, the Pittsburgh Section received the “Outstanding Large Section” award for its activities in 2005. 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, and the PES R2 Representative (2010 and 2011). He has been serving as an IEEE PES Distinguished Lecturer since 2002. In that capacity, he has given presentations on power flow control technology in over 80 places around the world. Currently, he is serving as the founding Chair of IEEE Pittsburgh Power Electronics Society Chapter and a Member of the IEEE Center for Leadership Excellence Committee (2013, 2014).

Please contact Shan Pandher [shan.pandher@ieee.org] if you have any problems registering for the tutorial, or if you have any questions.