Tutorial:

Physical and Market Mechanisms for the Non-Power Systems Professional

Instructors: ***Carl Kropp & Aidan Foss***

The tutorial is intended for the non-power system professional. The objective is to provide the participant with:

- Familiarization with the language of the power system professional and the electricity trader.
- An understanding of the operating constraints of the electric power system and how they affect electrical energy transfer and trading.
- A review of the new electricity industry structure and trading arrangements in Ontario

Ontario Power System Overview

Over the past century, power systems across the world have evolved according to similar principles, involving three-phase alternating currents with frequencies of either 50 or 60Hz. Large generating stations, supporting the system frequency and voltage profile, generally form the backbone of these systems. As it is impractical to store electrical energy in significant quantities, the power system operates like a single gigantic machine with electrical power produced by the generators just as it is required by the loads. Attendees be introduced to:

- *Key characteristics of modern power systems*
- *Generation, transmission, distribution and load.*
- *Active and reactive Power*
- *Overview of the Ontario electricity system including voltage levels, network and substation configurations, interconnections and generation mix.*

Transmission Constraints

The power system plays a pivotal role in enabling conditions for an electrical energy market to exist. Ideally, there should be no limits on the power transfer capability between generators and consumers. In practice, however, the power system is designed and operated to specified levels of reliability and power transfer. Attendees will be introduced to:

- *Thermal constraints and boundary transfer capability*
- *Voltage constraints, voltage management and reactive power balance*
- *Electromechanical constraints and the maintenance of synchronism*
- *Technologies for enhancing power transfer capability: fixed, controllable and FACTS devices*

Power System Management

Power System Management involves the economic provision of services for energy balancing and for the maintenance of power system integrity. The former creates a requirement for power transfer, whereas the latter service places constraints on the amount of power that can be transmitted. Together they require real-time adjustment generation to match demand, with on-going assessment of the system integrity, and long-term investment planning to provide the necessary infrastructure. Attendees will be introduced to:

- *Demand profiles, energy balancing, frequency management & reserves*
- *Load duration curves, baseload and peaking plant, merit & bid orders*
- *System planning and operating standards: NERC, OEB, IMO*
- *System monitoring and control*
- *Contingency analysis for power system operation and investment planning*

Ontario Deregulated Trading Arrangements

Prior to 1998, the Ontario public electrical utility was a vertically integrated monopoly. In response to increasing concerns, particularly regarding debt, the Electricity Act was passed in 1998 which unbundled the industry and introduced competitive trading in energy. This involved a wholesale market with time-of-day spot pricing, and options for bilateral trading. At the retail level, it introduced unbundled billing with options for financial hedging. Attendees will be introduced to:

- *Historical review of the reasons for change in Ontario.*
- *The 1998 Electricity Act and the changes it introduced*
- *Your new electricity bill.*
- *How the spot price is determined*
- *The Market Power Mitigation Agreement*
- *The Standard Supply Service and retail financial hedging options*

Presenter Biographies

Carl Kropp BSc (Eng), BSc, MSc, MIEEE, P.Eng. has an academic background in electrical engineering and mathematics as well as 42 years of experience in the electrical utility industry. Before retirement, he served for 16 years as General Manager and Chief Engineer of Ottawa Hydro. While in industry, he undertook a major role in both the Canadian Electricity Association and the Municipal Electric Association (Ontario) Research and Development Programs. He also served as Chair/President of both organizations and received their Distinguished Service Awards. His primary interest is in electric power distribution and utilization but he has also worked in transmission and generation. Currently he is an Adjunct Professor in the Department of Electronics at Carleton University.

Aidan Foss MA(Cantab), PhD, CEng, MIEE, MIEEE graduated in mathematics from Cambridge University, England and completed his PhD on gas turbine control with Imperial College, London. From 1976 to 1990, he specialized in applications of computer control & simulation with the National Gas Turbine Establishment, Dowty Electronics and Cambridge Control. In 1990, shortly after the deregulation of the UK Electricity Supply Industry, he joined the National Grid Company, designing extensions to the UK transmission system. His subsequent responsibilities included auditing the performance of generator control systems, new technologies for enhancing power transfer, and power quality. In 2001, he moved to Ottawa where he is a consultant on power and control systems. He is the Secretary of the Ottawa branch of the IEE, a member of the IEEE Power Engineering Society and an Associate of the Institute of Energy.