POWERCON2008 Tutorials
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Power System Restoration

by
M. M. Adibi
IEEE PES Distinguished Lecturer
madibird@aol.com

Abstract: The primary objectives in power system restoration are: reduction of outage duration, minimization of the un-served loads, and avoidance of equipment damage. The restoration process depends on power system characteristics as related to real and reactive power balance, and the installed control and protective systems. The process is also a function of pre-disturbance conditions, post-disturbance status, and post-disturbance target systems. This one-day tutorial covers the following six topics:

Topic 1: Restoration Overview and Issues
Topic 2: Real Power Balance and Control of Frequency
Topic 3: Reactive Power Balance and Control of Over-voltages
Topic 4: Reactive Power Resources and Black-start
Topic 5: Protective System Issues and Controlled Separation
Topic 6: Restoration Dynamics and Graceful Degradation

For further reading:
Power System Restoration - ***Methodologies & Implementation Strategies***
By: M. M. Adibi,
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M. M. Adibi

Earned the B. Sc. E. E. (honors) in 1950 from the University of Birmingham, U.K., the M.E.E. in 1960 from Polytechnic Institute of Brooklyn, New York City, and Nuclear Engineering in 1970 at the University of Santa Clara, California. He has spent over 50 years in the service of electric utilities, assuming various responsibilities including; manufacturing and testing of heavy electrical equipment at General Electric Company, U.K. (1950-1951); operation and maintenance of large thermal power plants at British Petroleum, Iran (1952-1955), where he was promoted to power plant superintendent; and power system planning at EBASCO International, New York (1956-1959), where he was in charge of developing 10-year construction programs for several Central and South American Utilities.

In 1960, Mr. Adibi joined IBM Corporation, developing computer applications in the engineering and operation of electric utilities. As the industry consultant, he conducted and participated in many R&D projects related to operation of power system and power plant operation, and advanced network functions. He was the recipient of the IBM Industry Grant to study the computer-based fuel model for the power industry.

Since 1979 he has assumed industry leadership by founding and chairing the IEEE System Restoration Working Group. He has addressed many restoration issues in the 27 IEEE Transaction papers in which he is the principal author, and he has organized many paper and panel sessions at the meetings of the IEEE Power Engineering Society. His effort culminated with the publication of “Power System Restoration – Methodologies and Implementation of Strategies,” by the IEEE Pres in alliance with John Wiley & Sons. Mr. Adibi is the recipient of the IEEE Power Engineering Society's prize for his paper on "Power System Restoration Planning." He is an IEEE Life Fellow.

Mr. Adibi is currently president of IRD Corporation, Chartered Engineer, Institute of Electrical Engineers (IET), U.K., and a registered professional engineer in the state of Maryland, USA.

The Role of Technologies, Tools and Techniques for Planning and Automation of Future Distribution Systems

by
S. S. (Mani) Venkata
IEEE PES Distinguished Lecturer

Professor of EE, University of Washington
Professor and Chair Emeritus of ECE, Iowa State University

ABSTRACT

During the past two decades electric power systems have witnessed unprecedented changes. Utility restructuring due to deregulation calls for increased operational efficiency, reliability, security, and cost-effective electric energy supply to customers. In addition, the following have provided the needed impetus to meet the new challenges and opportunities to utilities around the world: the emergence of new sustainable energy sources and technologies, measuring devices and sensors, more powerful and refined communication systems, highly advanced computing equipment, advanced power electronic devices, and new control and protection ideas. Thus electric utilities are aiming to realize "Smart Grid" that will characterize the distribution systems of the future.

This one-day workshop will identify prospects for future distribution systems. In so doing the role of new technologies, the need for new techniques and tools will be addressed in detail. Potential attendees are encouraged to come up with searing questions to explore new ways to plan and operate medium- and low-voltage distribution systems in order to meet all the objectives identified above.

S. S. (Mani) Venkata

S. S. (Mani) Venkata is a Fellow of the IEEE. Mani has offered training courses on distribution systems, planning and automation, power quality, reliability and safety and power system analysis to more than 20 utilities, industries and federal agencies. He has also provided technical and consulting services to many electrical and process industries. He has published and/or presented over 300 publications in refereed journals and conference proceedings, and a co-author of the book *Introduction to Electric Energy Systems* Prentice-Hall Publications, 1987. He is a registered professional engineer in the states of Washington and West Virginia.

Mani is President of Venkata Consulting Solutions Inc. He is also teaching at the University of Washington, Seattle, WA as Professor of Electrical Engineering. Until recently Mani was with KEMA as Vice-President. Prior to 2005, he has held administrative and academic positions at Clarkson University, Iowa State University, University of Washington, West Virginia University and University of Massachusetts. He has been very active in the IEEE for the past 40 years. Currently he serves as a member of the Power Engineering Society (PES) Executive Committee and Governing Board and as the Vice-President of Publications. In 1996 he received the Outstanding Power Engineering Educator Award from the IEEE Power Engineering Society. He also received the Third Millennium Award from the IEEE in 2000.

New and Renewable Energy Sources
by
Saifur Rahman
IEEE PES Disinguished Lecturer

Joseph Loring Professor of ECE
Director, Advanced Research Institute
Virginia Tech, Arlington, VA, USA
Email: srahman@vt.edu

This tutorial examines the state-of-the-art and opportunities provided by renewable energy-based distributed generation technologies to meet the challenges of a sustainable energy system worldwide. It explores the renewable energy technologies like solar, wind, hydro and geothermal. It provides a history of the growth of these technologies throughout the world during the past 10 years, and traces the cost, size and country-specific penetration issues in certain countries where the growth has been significant in the past, and expected to continue. It also highlights the major renewable energy generation expansion plans in several countries which have made significant commitments in this regard. In this context the tutorial addresses the issues of renewable portfolio standards (RPS) and feed-in tariff approaches being used in different countries with various levels of success. In addition, the very significant opportunities to provide electricity for lighting and small commercial use in many rural parts of the world by promoting renewable energy are also explored.

The market penetration and energy cost issues as well as environmental concerns from renewable energy technologies are examined. In this context the capacity factors and capacity credit issues from renewable energy based power plants are discussed. This is followed by a price comparison of renewable energy derived electricity with respect to power generation from natural gas, coal and nuclear power plants.

Professor Saifur Rahman

Saifur Rahman is the director of the Advanced Research Institute at Virginia Tech where he is the Joseph Loring Professor of electrical and computer engineering. He also directs the Center for Energy and the Global Environment at the University. Professor Rahman has served as a program director in engineering at the US National Science Foundation between 1996 and 1999. In 2008 he is serving as the vice president for New Intiatives and Outreach for the IEEE Power & Energy Society. In 2006 he served as the vice president of the IEEE Publications Board, and a member of the IEEE Board of Governors. He is a distinguished lecturer of IEEE and in that capacity he has spoken on energy, environment and infrastructure related issues in over 20 countries in Asia, Europe, Africa, Australia and North America.

FACTS Controllers and their Modeling Techniques
by
Dr. Kalyan K. Sen, P.E.
IEEE PES Distinguished Lecturer

The power industry's quest for the *most economic way to transfer bulk power along a desired path* can only be achieved through the independent control of active and reactive power flow in a transmission line. Traditional solutions, such as shunt inductor/capacitor, phase-shifting transformer, and series inductor/capacitor affect both the active and the reactive power flow in the transmission line simultaneously. With the use of Voltage-Sourced Converter (VSC)-based Unified Power Flow Controller (UPFC), the active and the reactive power flow in the line can be regulated independently. Since the field demonstration of the world's first UPFC in 1998, another Flexible Alternating Current Transmission Systems (FACTS) controller, namely Sen Transformer (ST), has been proposed. In contrast to the UPFC, which uses a large number of solid-state switching devices, the ST uses time-tested components, such as transformer and load tap changers, but provides the same independent active and reactive power flow control as the UPFC at a much lower cost.

The objectives are to give a background on traditional power transmission technology and discuss new techniques that utilize the transmission lines most effectively. The workshop covers various types of FACTS controllers and their usefulness in power system applications. Various modeling techniques of FACTS controllers are discussed. The results from the simulation are compared with those from the field measurements. This presentation is of particular interest to all power-engineering professionals. The required background includes an electrical engineering degree with familiarity in power engineering terminology.

Kalyan K. Sen received B.E.E, M.S.E.E, and Ph.D degrees, all in Electrical Engineering, from *Jadavpur University*, India, *Tuskegee University*, USA, and *Worcester Polytechnic Institute*, USA, respectively. He has spent over 20 years in academia and industry. He was a member of the FACTS development team at Westinghouse Science & Technology Center in Pittsburgh, USA. He contributed in all aspects (conception, simulation, design, and commissioning) of FACTS projects at Westinghouse. Dr. Sen conceived some of the basic concepts in FACTS technology. He has many publications in the areas of FACTS and power electronics. Currently, he is a Fellow Engineer at the Curtiss-Wright Electro-Mechanical Corporation (formerly Westinghouse) in USA where he is engaged in power electronics applications research. His interests are in *Power Converters*, *Control*, *Electrical Machines*, and *Power System Simulations and Studies*. He is a licensed Professional Engineer.

Dr. Sen, a Senior Member of IEEE, has served the organization in many positions. In 2003, he re-established the Pittsburgh Chapters of the Power Engineering Society and the Industry Applications Society. Both Chapters received the "Outstanding Large Chapter" awards for the year 2004. Under his Chairmanship, the Pittsburgh Section received the "Outstanding Large Section" award for the activities in 2005. He has been a Distinguished Lecturer and served as an Editor of the IEEE Transactions on Power Delivery.