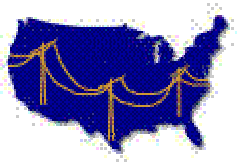

Modernizing the National Electric Power Grid

Presentation Summary

Title: Increasing Transmission Capacity, Grid Control and Stability

Speaker: Massoud Amin, EPRI

Session	Session #1: Overall Perspective
Summary	Today's transmission grid does not provide the capacity, control, or stability required to meet critical 21st-century challenges, such as increasing power reliability, ensuring power quality, and improving power security. A comprehensive transmission grid expansion plan will help to identify and prioritize areas of greatest need. A wide area measurement system will support 24x7 grid monitoring, providing the data that other systems will require to identify possible trouble or respond to events. A self-healing grid system will offer instantaneous response to changes in market conditions as well as natural and man-made events. Background: A Case Study In a white paper issued in June 2001, EPRI presented technical recommendations for solving the power crisis that began in California in 2000 and involved the 11-state Western power grid, with the potential for expanding further. The recommendations are backed by a diverse group of more than three dozen stakeholders from California and other Western States who attended a workshop held at the EPRI headquarters earlier in June 2001. Among the recommendations: · Upgrade existing power plants to increase their capacity by 5% through advanced maintenance procedures, diagnostics, and cost-effective retrofits. · Repair dysfunctional wholesale/retail power markets. · Improve existing transmission capability to achieve more throughput · Pursue a balanced portfolio of generation sources to avert an over-reliance on natural gas · Accelerate interconnection of clean distributed generation into the power grid to provide back-up support · Develop and implement a comprehensive architecture for the power supply infrastructure that anticipates the rapidly escalating needs of the digital society The white paper contains 18 specific actions to help resolve the current power crisis in the Western region, as well as to establish a transition pathway to a sustainable electricity infrastructure. In addition to regulatory and market reforms, all the recommendations require the introduction of new enabling technology to meet the objectives in a cost-effective timely manner. The entire report is available at http://www.epri.com/WesternStatesPowerCrisisSynthesis.pdf The Need for Increased Transmission Capacity, Grid Control and Stability The North American power grid, once called "the most complex machine ever invented," consists of four regional systems, each of which is a complex, integrated web of transmission lines and power plants. With demand for electricity increasing at an annual rate of 1.5-2 percent each year and rapid spreading of digital technologies that require

	ultra high-quality electricity, the strain on this power grid is beginning to show. In 1996, an overloaded line in Oregon sagged into a tree. The resulting chain of events overwhelmed all system defenses, causing losses of $1.5 to $2 billion over 1.8 million square miles. Growing demand pressures will intensify the strain on the grid. The many small generation and storage devices ("distributed resources") now appearing throughout the grid must be integrated into the existing system to avoid the risk of major overloads. And today's facilities are aging, performance is declining, and maintenance requirements are rapidly increasing. Next Steps: Emerging Solutions Major upgrades are necessary to provide power service at the level of reliability already required by many customers. More will be required to meet forecast needs for power quality, reliability, security, and availability at low cost. The first step is the completion of regional and national plans for power grid expansion and enhancement. Then a broad range of new technologies will be needed to allow the system to work as needed. Component-level innovations, such as composite materials, embedded fiber optics, and high-strength cables, will offer enhanced reliability. Power electronics-based integrated network control (using new post-silicon power electronics) promises to increase the capacity of transmission lines and improve overall system reliability. A self-healing grid system will be much more responsive to changes in electricity demand as well as to natural and man-made events. Wide area measurement systems on the national level will provide critical raw data required by the self-healing system as well as new security systems.
Bio	Dr. Massoud Amin is Area Manager, Infrastructure Security, Grid Operations/Planning and Power Markets at the Electric Power Research Institute (EPRI) in Palo Alto, California. He directs all security related research and development at EPRI, including the Infrastructure Security Initiative (ISI) and the Enterprise Information Security (EIS). Prior to his current responsibilities, he served as manager of mathematics and information science at EPRI, where he led strategic research in modeling, simulation, optimization, and adaptive control of complex interactive networks, including national infrastructures for energy, telecommunication, transportation, and finance. At EPRI, Dr. Amin has developed collaborative research initiatives with diverse groups, including electric power industry, the government, universities and other stakeholders (including EPRI and its members, the US DOD, DOE, NSF, National Governors' Association, NAE, and the White House OSTP). He has been responsible for leadership in all aspects of planning and management of strategic R&D, creation of inter-disciplinary initiatives and application of advanced technologies to decision-aiding and engineering problems from conceptual design through implementation for energy and other large-scale networks. This has primarily involved creation and successful launch of the Complex Interactive Networks/Systems Initiative (CIN/SI), which was initiated in mid-1998 in response to growing concerns over the vulnerability of critical national infrastructures. CIN/SI developed six research consortia consisting of 108 professors and over 200 researchers in 26 U.S. universities, along with two energy companies, co-funded equally by EPRI and the U.S. DOD. Prior to joining EPRI in January 1998, he held positions of associate professor of systems science and mathematics and associate director of the Center for Optimization & Semantic Control at Washington University in St. Louis, Missouri. During his twelve years at Washington University, he was one of the main contributors to several projects with United States Air Force, NASA-Ames, Rockwell International, McDonnell Douglas, Boeing, MEMC, ESCO, Systems & Electronics Inc. and United Van Lines. While at Washington University, he focused on theoretical and practical aspects of intelligent

	controls, on-line decision making, system optimization, and differential game theory for aerospace and transportation applications. He is the author or co-author of more than 90 research papers and the editor of six collections of manuscripts, and serves on the editorial boards of four academic journals. At Washington University, students voted him three times Professor of the Year (voted annually by seniors in the School of Engineering and Applied Science at Washington University, 1992-1995), Mentor-of-The-Year (Assoc. of Graduate Engineering Students, Feb. 1996), and the Leadership Award (voted by the senior engineering class, May 1995). Dr. Amin received Best Session Paper Presentation Awards (American Control Conference, 1997) and an AIAA Young Professional Award (St. Louis section, 1991). At EPRI he has received several awards including the 2002 President's Award for the Infrastructure Security Initiative, 2000 Chauncey Award (the highest annual EPRI Award), and six EPRI Performance Recognition Awards during1999-2002 for leadership in three areas. He is a member of the Board on Infrastructure and the Constructed Environment (BICE) at the U.S. National Academy of Engineering, Sigma Xi, Tau Beta Pi, Eta Kappa Nu, a senior member of IEEE, AAAS, AIAA, ASME, NY Academy of Sciences, SIAM, and Informs. He is a member of the IEEE Computer Society's Task Force on Security and Privacy. Dr. Amin holds B.S. (cum laude) and M.S. degrees in electrical and computer engineering from the University of Massachusetts-Amherst, and M.S. and D.Sc. degrees in systems science and mathematics from Washington University in St. Louis, Missouri.