

Power Delivery & Utilization Update

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Vice President's Message



As we reach out to you for the first time in 2008, I'd like to share the enthusiasm and optimism we are feeling at EPRI and the Power Delivery and Utilization sector of the company. In 2007 the company's funded research programs grew by 9% to \$308M, continuing a recent growth trend. The Power Delivery and Utilization sector delivered

on its commitments and contributed to this success as our funded research programs grew by 11% to \$69M. These results serve as a great springboard for future success.

As we look ahead, we are motivated by the opportunities to conduct research that is of great value to our members. Our programs deal with some of the most challenging issues our members face including helping

to increase reliability and performance of the grid and reaching a higher level of carbon mitigation through the integration of distributed generation and renewables. These are areas we think we can help with. We are also involved in exciting programs that will in the near future lead our society to rethink the role electricity plays in our every day life, such as with our plug-in hybrid vehicle program. This can have impact, as research has proven that switching to electricity for certain processes will increase overall efficiency and minimize carbon output. There are even more examples, but what we really want to do is to work with our members to identify demonstration projects that will take our research projects into the field and prove their value. Can you imagine the impact we'll have with widespread adoption of these programs?

We have the resources to produce results and have impact with our members. Our team includes recognized experts looking at the challenges the industry faces. These people have served in a variety of capacities at utilities, manufacturers, consultants, government agencies and service providers to name a few. Their deep understanding of the issues gives us the ability to develop focused programs others can't offer. Additionally, we manage three laboratories where we can put our research into action.

It is exciting to talk about our research. It is even more exciting to talk about bringing that knowledge into a real world setting and learning from it. On the following pages you will see summaries of this year's Technology Transfer award winners. Our company presents these awards annually to acknowledge those who have made significant contributions in the application and use of our research. In the Power Delivery and Utilization sector, we presented 13 awards to utilities that demonstrated their leadership and are seeing value from their investment in the technology.

This is what we would like to see from all of our member companies. Is this something you can envision for your organization? We hope so and we'd like to help you get there. We made great strides in 2007 and I think 2008 can be even better. Thanks for your continued support of our organization.

Sincerely,

Arshad Mansoor

Vice President, Power Delivery & Utilization

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Success Stories: Utilities Apply EPRI Products to Improve Reliability, Cut Costs, and Improve Customer Service

Lincoln Electric System Improves Transformer Condition Assessment with EPRI Methodology

EPRI's approach uses a utility's existing data and information infrastructure to rank transformers based on their condition and to identify at-risk units for detailed assessment.

The ranking enabled Lincoln Electric System (LES) to identify the 10 highest-risk units for detailed testing, the results of which could ultimately help add insight to transformer replacement and refurbishment decisions. The project also provided valuable lessons and raised awareness of what parameters influence the transformer fleet, and how.

Read the full story on epri.com (product # 1016350).

EPRI Conference Promotes Power Switching Safety and Reliability

The 11th annual EPRI Power Switching Safety & Reliability Conference took place at the Radisson Plaza Hotel in Lexington, Kentucky, in September 2007. For two days, 165 utility representatives from the U.S. and nine other countries met to hear experts in situation awareness and human performance describe how utilities can redesign their control rooms and procedures to ensure safe and reliable power switching operations.

The 12th Annual Power Switching Safety & Reliability Conference will take place September 15–16, 2008, at the St. Anthony Hotel in San Antonio, Texas. Registration for the Conference through Cvent—the EPRI on-line registration system—will open by March 2008.

Read the full story on epri.com (product # 1016349).

Tri-State Uses EPRI's PRA Program to Optimize Sequence of Transmission Construction

The Probabilistic Risk Analysis (PRA) program helped the utility decide what sequence to add new transmission lines to meet growing load, building the most beneficial line first and adding the others later in accordance with their rank.

Read the full story on epri.com (product # 1016222).

CPS Energy Optimizes Asset Management, Boosts Staff Productivity and Enhances Service Reliability with EPRI's Maintenance Management Workstation

EPRI's Maintenance Management Workstation (MMW) enables CPS Energy to track and trend circuit breaker operations and target long-inactive breakers for maintenance to ensure their reliable operation.

Read the full story on epri.com (product # 1016305).

Consolidated Edison Enhances Substation Reliability and Safety with Maintenance Management Workstation

EPRI's MMW and expert support services helped Con Edison develop an automated work-order notification to strengthen and streamline regulatory compliance, improve power system reliability and safety, and reduce costs.

Read the full story on epri.com (product # 1016398).

NYPA Saves \$7 Million for Cable Replacement With Advanced Diagnostics to Assess Cable Condition at Niagara Power Project

NYPA collaborated with EPRI's Underground Transmission Program for the diagnostic testing and condition assessment of its high-pressure fluid-filled (HPFF) cable systems at Niagara Power Project. EPRI has been leading the research of underground cable aging, diagnostics and life expectancy for more than 30 years. Utilities have avoided unnecessary and costly cable replacement with the advanced diagnostics provided by EPRI and its contractors.

Read the full story on epri.com (product #1015245).

Consolidated Edison Captures Expertise of Retiring Chief District Operator to Preserve Safety and Reliability

EPRI's Human Performance Technology Program has developed tools and a streamlined process for capturing expert knowledge that are unique in the industry. The process involves three stages: identifying the valuable knowledge to be captured, planning which tools would be most effective at capturing the identified expertise, and implementing the plan, resulting in knowledge modules that can be easily transferred to others.

Read the full story on epri.com (product # 1016118).

Power Delivery and Utilization Sector Honors Tech Transfer Award Winners

EPRI's Power Delivery and Utilization Sector honored the recipients of the sector's Technology Transfer Awards for 2008 at the Coronado Marriott Resort in California in February. These annual awards are presented to EPRI-member utility personnel who have proven themselves to be leaders in applying EPRI technology or who have given exceptional service to the industry.

"The Tech Transfer Awards recognize and honor those who put EPRI research results to work for the benefit of utilities and their customers," said Arshad Mansoor, Vice President of the Power Delivery and Utilization Sector. "The awards highlight the value of collaboration in addressing the challenges facing our industry. Working together, utilities and EPRI can tackle problems and develop solutions that lie beyond the ability and resources of any single organization. The awards also demonstrate the breadth and depth of our R&D activities, which cover the entire spectrum of power delivery and utilization."

The following individuals and teams received Technology Transfer Awards:

Overhead Transmission

Alan Holloman, Ed Watson, Ricky Williams, Stephine Hill, Buddy Phillips, and Steve Williams of Georgia Power for the development and implementation of an EPRI Subgrade Corrosion Testing Facility at the Southern Company Klondike Training Center. The test facility will be at the center of the EPRI subgrade corrosion research for the foreseeable future providing valuable results and a training resource for the industry.

Eric Engdahl of AEP and Dennis Mize of Southern Company for working closely with EPRI in developing and sponsoring the first ever EPRI AC Transmission Line Reference Book (Red Book) Seminars to be held at EPRI member sites, and the first such seminars based on the 3rd edition of the landmark reference on transmission line design. The seminars introduced engineers to the Red Book and helped educate them in the electrical aspects of overhead transmission lines. Training was provided by Redbook authors.

Dr. Dong-Il Lee and Yunseok Lim of Korea Electric Power Research Institute for applying EPRI research results on aging of 765kV transmission line polymer insulators at the Gochang Test Site. Findings will help

utilities building 765kV lines to take advantage of the lower weight and contamination performance of polymer insulators and realize significant cost savings without sacrificing reliability in contaminated environments.

Increased Transmission Capacity

James Kozlosky, John Gest, and Carl Bridenbaugh of FirstEnergy for working with EPRI to improve the accuracy, convenience, and reliability of power equipment rating calculations. Projects involved the integration of power transformer components of the EPRI thermal model library into the FirstEnergy line rating (K03) program and the evaluation of the EPRI Sagometer and Dynamic Thermal Circuit Rating (DTCR) software for the calculation of dynamic line ratings on FirstEnergy's Canton-Central-Cloverdale 138-kV line. The software will help utilities to increase equipment ratings to transfer more power on existing transmission corridors and thus increase revenues, while increasing reliability by monitoring equipment status.

Chuck Bennett of CenterPoint Energy for visionary leadership, promotion of industry collaboration, and multiple contributions in support of the development of High-Temperature Low-Sag (HTLS) conductor technology, which led to the successful commercialization of HTLS. A HTLS conductor is able to carry higher current than a conventional ACSR conductor, thus reducing the number of new transmission lines required or overcoming capacity shortage of an existing line. The application of a HTLS conductor benefits the power industry both financially and environmentally.

Substations

Clint Johnson and Rick Maldonado of CPS Energy for novel application of EPRI's Maintenance Management Workstation (MMW) and Industry wide Equipment Performance Database (IDB) to improve asset management. Using MMW and IDB, CPS staff can access and analyze a wealth of network data to monitor and assess equipment condition such as transformer loading or circuit breaker operation. With this data and the insight it provides into system operation, CPS has developed approaches to streamline and improve maintenance, reliability, and staff productivity.

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Members of the Energy Efficiency interest group that received a Technology Transfer award.

Tech Transfer Award Winners

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Joe Lang, Larry Streit, and Paul Dinges of Lincoln Electric System (LES) for applying EPRI's condition-driven fleet scanning methodology for substation transformers. The methodology ranks transformers based on their condition and identifies at-risk units for detailed assessment. As a result, LES can make better decisions regarding transformer repair and replacement, and ultimately strengthen system reliability while reducing maintenance costs.

Grid Planning

Liana Hopkins and Bruce Fardanesh of New York Power Authority, Jim Useldinger and Prakash C. Patro of Kansas City Power & Light, and Dillwyn Ramsay and Mark Graham of Tri-State for supporting the development and implementation of EPRI's Probabilistic Risk Assessment (PRA) methodology for transmission reliability studies and transmission planning. PRA helps system planners visualize their system reliability and its interaction with neighboring areas. It helps them recognize the critical contingencies that have both high probability and high impact, and develop effective remedial mitigation schemes, thereby improving transmission system reliability.

Distribution Systems

Christopher Jones of Con Edison for leadership in the development and implementation of a distribution fault locating system implemented with EPRI's PQView platform and Con Edison's substation power quality monitors. The system has significantly reduced the fault repair time for Con Edison's distribution circuits, increasing crew efficiency and system reliability. Lessons learned in the implementation will help other utilities as they employ fault locating systems.

Power Quality

Kevin Kittredge of Salt River Project (SRP) for taking personal responsibility for integrating WebPQView into SRP's power quality data Internet website. WebPQView provides SRP's customers with web-



based access to SRP's power quality measurements. The WebPQView site is attracting very positive feedback from SRP's commercial and industrial users.

IntelliGridSM

Richard Schomberg of Electricite de France for facilitating the submission and approval of the EPRI IntelliGrid methodology to the International Electrotechnical Commission (IEC) as a Publicly Available Specification. EPRI's IntelliGridSM Program developed the methodology to capture requirements for Smart Grid applications and has worked with several utilities to apply the methodology. Publication of the methodology by the IEC exposes it to a much wider audience and it validates the quality and value of the work.

Joe Waligorski and Ken Wirt of FirstEnergy for their vision and project coordination in using the IntelliGrid Architecture to develop an advanced roadmap for FirstEnergy's intelligent grid infrastructure. The roadmap will be the foundation for implementing intelligent technologies and systems over the next 10 years at FirstEnergy. This effort will result in dramatically improved reliability and quality for customers, while achieving more efficient operations. The FirstEnergy example is a best practices example of how the IntelliGrid research can provide the foundation for such an effort.

Energy Efficiency

Eva Gardow of FirstEnergy, Karen Smith of SRP, John Richardson of TVA, and Pradeep Vitta of Southern Company for leadership and strategic support that led to formation the Retail Interest Group as a precursor for industry-wide and EPRI-led Energy Efficiency Initiative. The group has accelerated understanding of strategic value of technology applications such as heat pump water heaters, geothermal heat pumps, high efficiency lighting and new motor/drive designs.

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com).



Jim Useldinger and Prakash Patro from Kansas City Power & Light pose with Arshad Mansoor.

Combating Corrosion: EPRI Teams with Southern Company on Research to Benefit Industry and Public

Collaborative effort at the Klondike test facility will enhance understanding of corrosion of transmission structures, develop improved inspection and mitigation methods.

EPRI and Southern Company are tackling a major challenge facing the power delivery industry: corrosion of overhead transmission infrastructure, which costs utilities millions of dollars per year in repair costs and loss of asset value. Through an ongoing collaborative project at Southern Company's Klondike test facility, researchers are determining the corrosion rates of different types of corrosion on different structures, evaluating new and emerging inspection methods, and developing mitigation tools. Results will help utilities identify optimal inspection and monitoring techniques to detect corrosion and develop cost-effective corrosion management and mitigation strategies.

"There's no such thing as maintenance-free infrastructure and no such thing as a silver bullet," says EPRI Project Manager Neal Murray. "What's needed is an array of different tools to not only find corrosion, but also to mitigate it. An inspection tool that may work on a steel pole may not work on a lattice tower, and a completely different tool may be needed for an anchor rod."

The Klondike test facility is designed to evaluate new and emerging inspection methods using test specimens with known levels of corrosion. Specific flaw types of various sizes and depths below groundline are inserted

into the test specimens to allow five common corrosion types to propagate. After a predetermined length of time, service providers can demonstrate various inspection technologies and the accuracy of that assessment can then be analyzed. The resulting corrosion rates and the environmental factors driving the corrosion kinetics can be re-quantified so that identical structure constructions and soil conditions throughout the world can be understood.

The project is also conducting complementary research at EPRI's Charlotte electrochemical test laboratory, where researchers are quantifying the effects of specific chemical compounds, soil moisture, aeration levels and temperature. In addition, findings from both facilities will be applied to understand the environmental factors of several supplemental projects with Tennessee Valley Authority. The objective is to improve our understanding of corrosion types, corrosion rates and to assess cost-effective inspection methods for steel poles and zinc counterpoise grounding systems.

In 2007, researchers began installing steel poles and anchors at Klondike. In 2008 the project team will complete the evaluation of inspection methods and deliver information on appropriate tools for different types of infrastructure. In 2009, the project will begin installing and evaluating lattice towers. Structures scheduled for future research may include concrete poles, concrete foundations, and weathering steel.

For more information, please contact Neal Murray, 704.595.2126, nmurray@epri.com.

2008 EPRI Substation Equipment Diagnostics Conference: March 3–5 in Orlando, Florida

This conference will focus on assembling, assessing, and communicating information on the latest diagnostic techniques, test devices, and systems for substation equipment. Utility executives, managers, and engineers with responsibility for substation design, construction, operations, and maintenance are invited. Manufacturers, university faculty and students are also encouraged to attend.

This conference will be the fifteenth in a series that began in 1992. The objective of the conference is to bring together the perspective and expertise from researchers, manufacturers and users. The conference

highlights the latest diagnostic equipment and techniques being developed by EPRI and others in research programs as well as the latest in equipment and programs available and utilized by utilities. The conference will be organized around three technical areas to include transformers, circuit breakers and other substation equipment plus communications, data management, and system integration.

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com).

International Conference on Overhead Lines: March 31–April 3 in Fort Collins, Colorado

EDM and EPRI are working together to host the 2008 International Conference on Overhead Lines – Design, Construction, Inspection, and Maintenance. Utility executives, managers, and engineers with responsibility for transmission, distribution, substation design, construction, and operations and maintenance are invited.

The conference will focus on technologies and resources to support the leading corporate objectives of electric utility companies today: reduce operations and maintenance costs, increase power throughput, and improve line reliability. To this end, the technical papers will also address the related areas of extending overhead line and component life; reducing design, refurbishment, and construction costs; and ensuring

health and safety for workers and the environment. In addition, this conference will explore new technology applications that promise attractive future alternatives for overhead line owners.

The conference objectives are:

- To provide a forum for professionals to explore the issues that impact the use of utility line structures throughout the world
- To exchange information on the state-of-the-art in research, technology, materials, maintenance, manufacturing, and design
- To showcase products and technologies through the commercial exhibition

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com).

New Substation Sensor Technology Locates Partial Discharge to Provide Early Warning of Equipment Failure

Antenna arrays continuously monitor an entire substation and pinpoint partial discharge signals from failing equipment without the need to add sensors to individual devices.

An international collaborative research project is successfully demonstrating a radio-frequency early warning system that uses an array of antennas to detect and accurately locate partial discharge (PD) signals from failing equipment throughout a substation. Prototype systems are deployed at TVA, Tri-State, SCANA Corporation, and Southern Company in the United States; Powerlink in Australia, and National Grid in the United Kingdom. The EPRI research is built on techniques originally developed in the University of Strathclyde. The success of the research has resulted in the formation of a university spin-off company which will continue to perform the research under the EPRI project. Additional utilities are welcome to join the research effort and install pilot systems at their own substations.

“Even though this technology is in the research phase, field deployments have already begun to identify failing equipment and results have allowed utilities to take preventive action before a failure,” says EPRI Substations Project Manager Luke van der Zel.

Partial discharge is a symptom of insulation degeneration that often precedes substation equipment failures. PD generates radio frequency interference, which can be used for non-invasive monitoring and early warning of incipient problems. The system consists of a four-

antenna array connected to a fast sampling acquisition unit that uses time-of-flight data captured by the array to locate discharge sources in three dimensions.

“The significance of this approach is that it continuously monitors the entire substation with a single sensor point—the antenna array,” says van der Zel. “It’s not necessary to instrument each piece of plant individually. It thus provides a cost-effective way to monitor a wide range of equipment types and reduce the risk of catastrophic failures.”

Further work will result in a fully developed online system that will continuously monitor and automatically report (via a web-based portal) the occurrence and location of potential insulation defects.

The antenna array is one of several sensor demonstrations under way at TVA’s Paradise substation in Drakesboro, Kentucky. Other substation sensor development and demonstration efforts include

- Acoustic emission technology that can detect, locate, and assess electrical and thermal faults inside power transformers
- Solid-state metal-insulator-semiconductor (MIS) sensor technology for low-cost, fault gas monitoring for online transformer condition assessment
- Wireless mesh sensor systems consisting of distributed autonomous sensor and communication devices for cost-effective substation online monitoring.

For more information, please contact Luke van der Zel, 704.595.2232, lvanderz@epri.com.

The Electric Power Research Institute (EPRI), with major locations in Palo Alto, California; Charlotte, North Carolina; and Knoxville, Tennessee, was established in 1973 as an independent, nonprofit center for public interest energy and environmental research. EPRI brings together members, participants, the Institute's scientists and engineers, and other leading experts to work collaboratively on solutions to the challenges of electric power. These solutions span nearly every area of electricity generation, delivery, and use, including health, safety, and environment. EPRI's members represent over 90% of the electricity generated in the United States. International participation represents nearly 15% of EPRI's total research, development, and demonstration program.

Together...Shaping the Future of Electricity

Electric Power Research Institute

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