installations of the systems and provide mitigation strategies to vendors and asset owners. The team of cyber researchers, control systems engineers and network engineers at the lab is widely recognized as the world's most knowledgeable and effective center of excellence in cyber security of control systems.

The result of all these assessment programs is an unparalleled body of knowledge about vulnerabilities in control systems. To put that knowledge to work to protect the critical infrastructure, INL experts working at the Control Systems Security Analysis Center funded by DHS developed education courses that teach asset owners and operators how to secure these systems. They recently completed a very effective new program called the control system cyber red and blue team advanced training course giving students hands-on understanding of how the vulnerabilities are exploited, what attackers can do, and how users may be able to mitigate the risk.

Even more valuable than the training is the Idaho National Laboratory's innovative "Cyber Security Procurement Language for Control Systems document," available at www.msisac.org. Again with funding from DHS, the lab and New York State Office of Cyber Security worked together to translate the findings from assessment projects into very specific contract clauses that asset owners can employ to require the vendors of these systems to bake security into new control systems they are delivering.

We have a long way to go to even begin to protect our control systems effectively. Attacks are accelerating from both criminal organizations and malicious nation-states. But the work of Idaho National Laboratory, supported by the Department of Energy and the Department of Homeland Security, provides the outlines of a road map to real progress in reducing the risk.

Alan Paller is director of research at The SANS Institute, an organization involved in computer security issues.

The Green Circuits Project

FOCUSING ON TRANSMISSION AND DISTRIBUTION EFFICIENCY

BY ARSHAD MANSOOR

Arshad Mansoor
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WE LIVE IN A WORLD WHERE THE demand for electricity continues to increase, not only as a result of normal load growth but also as a result of new loads like electric vehicles. It is becoming increasingly important to look beyond traditional generation for alternatives to meet supply needs including energy efficiency, demand management and renewable generation. As we look at opportunities for more efficient uses of energy, it is important to look at the entire supply chain. Transmission and distribution systems offer numerous opportunities for efficiency improvement.

While the industry is tasked by regulators to engage in end-use energy efficiency programs, few have considered options to reduce energy losses along the electricity delivery chain. In many cases, the efficiency gains that could be realized by reducing transmission-and-distribution losses or by improving plant operational efficiency can be in the same range as, or exceed, the potential of end-use efficiency savings.

The electric industry is currently spending approximately $2 billion per year in state and utility administered energy-efficiency programs in residential, commercial and industrial facilities. While there

are opportunities to be even more efficient on the end-use side, we also need to increase our efforts in generation, transmission and distribution. There may be some areas where the cost of saving a kilowatt of energy or reducing a kilowatt of peak demand is less than an end-use energy-efficiency measure. A kilowatt of energy savings is the same regardless of where we are achieving it, and we need to be aggressive in looking for opportunities to reduce losses along the end-to-end chain.

The Electric Power Research Institute is conducting research that focuses on identifying energy savings opportunities that exist in the distribution system, including load balancing, reactive power compensation, voltage management, coordination with distributed resources for loss reduction, and making loss management one of the functions of distribution automation systems, for example, system reconfiguration. An in-depth understanding of distribution loss-reducing technologies and economics can provide valuable insight when considering upgrades to existing circuits or building new circuits.

This Green Circuits research project is a field demonstration for the conversion of distribution feeders to reduced-loss circuits. More than 14 utilities are participating and more than 60 distribution feeders across the country have already been selected for the field demonstration to undergo conversion. Their performance will be evaluated by comparing the achieved loss reduction to the baseline established before the modifications were implemented.

Utilizing the detailed metering data collected by recently installed advanced metering infrastructure systems with advanced modeling capabilities can enable better loss estimation, identification of loss reduction opportunities and verification of improvements.

The scope of traditional distribution system metering and modeling may not be sufficient to evaluate distribution loss improvement opportunities. One of the first objectives of the Green Circuits project is to identify the level of metering and modeling needed to prioritize efficiency improvements for the various circuits being evaluated in the project. Initial data collection efforts have identified challenges that many utilities face in assimilating the data needed for these evaluations.

This research is a collaborative effort involving domestic and international distribution utilities located in different geographic regions. The large number of participating utilities and feeders will generate a comprehensive source of data that can improve the analysis with regard to modeling requirements, loss analysis methods, economics of different strategies, and general guidelines for loss management as a function of different circuit and customer load characteristics. The diversity of circuits will help to create a greater understanding of the impact and economics of distribution losses and mitigation options. Through this process we also need to understand reasonable economic loss-reduction levels, as well as more accurate loss estimations derived from feeder-wide interval-metering data. This research may also reveal possible drawbacks and risks that highly efficient circuits may place on our systems.

Managing distribution losses is rapidly becoming a priority and an opportunity to reduce fuel costs and carbon emissions without impacting the revenue stream from customers. The more data we collect, the greater the opportunity to make lasting changes and improve the overall distribution system efficiency. Through this research program, we can help to reduce the industry's carbon footprint while meeting resource adequacy.

Moving forward, it is important to remember that you can only manage what you measure.

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8-10	Energy Efficiency Washington	QL:	E19081
8-10	Smart Utility London	QL:	E19125
10-11	Substation Grounding Orlando, Fla.	QL:	E19030
10-12	Wind Power Schenectady, N.Y.	QL:	E18216
10-12	Renewable and Distributed Energy Nice, France	QL:	E18991

JANUARY

13-14	Web Self Service for Utilities San Diego	QL:	E19031
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