NREL
NATIONAL RENEWABLE ENERGY LABORATORY

ENERGY SYSTEMS INTEGRATION

ESI optimizes the design and performance of electrical, thermal, fuel, and water pathways at all scales.

INTEGRATE: EPRI/SCHNEIDER ELECTRIC

Demonstrating Distributed Resource Communications

As the nation and the world move toward more complex grid-control schemes, better communications are needed to enable such controls. For this reason, researchers and industry thought leaders from the Electric Power Research Institute (EPRI) and Schneider Electric are working with National Renewable Energy Laboratory (NREL) staff at the Energy Systems Integration Facility (ESIF) to demonstrate communication technologies for distributed energy resources.

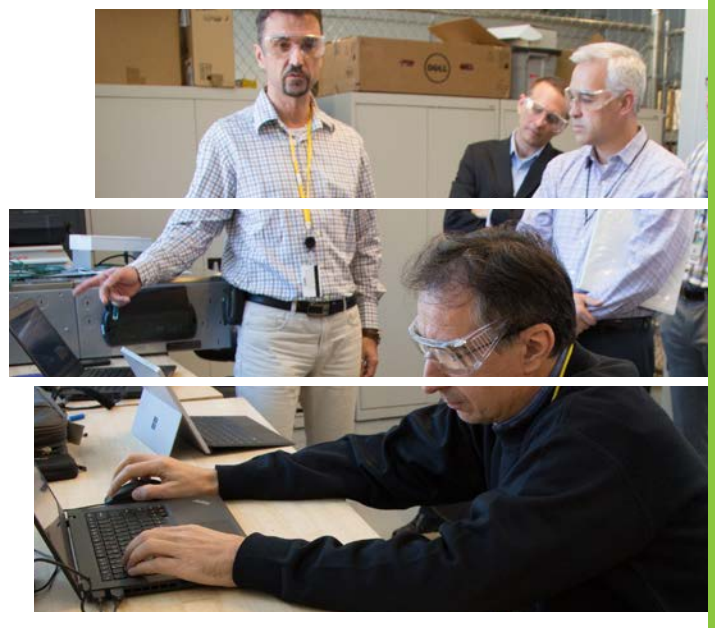
The ESIF project combines EPRI's distributed energy resource management system (DERMS) with Schneider Electric's advanced distribution management system (ADMS) to develop the communication, information, and computation (CIC) layers that support system-level grid control. The CIC framework includes an enterprise integration test environment, the ADMS, open software platforms, an open-platform home energy management system (HEMS), communication modules, and applications.

EPRI has designed and built and is now testing its open-source CIC infrastructure, which is enabling the team to improve the interoperability and intelligent control of multiple clean technology devices in a secure fashion. The flexible, consensus-standards-based infrastructure is well-suited for the integration and evaluation of high-penetration clean energy technologies. It is capable of tying together diverse resources ranging from the capacitors and voltage regulators that are the traditional tools of the distribution system operator, to large-scale DER systems, to customer-sited DER and loads.

The CIC infrastructure includes an Enterprise Service Bus (ESB), which allows messages to be passed between systems without the need for writing application- and data-model-specific code, greatly simplifying development and implementation. When an ESB is implemented in conjunction with a standard, a vendor can supply a generic adaptor that can be used to communicate with other systems by relying on standards-based messages. As the complexity of the information architecture increases, the ESB-based integration scheme can enable infinite scalability of the CIC.

Testing Five Communication Standards in Four Situations

The research setup in the ESIF includes a simulated 10-mile-long feeder, which ensures that the system architecture is consistent with that of an electric utility. The Schneider Electric ADMS was populated with a model of the electric network and configured to communicate with various feeder and edge devices, a demand response management system, and the EPRI DERMS. This provides the means to monitor the environment in real time, calculate the appropriate actions, and initiate automatic control commands to satisfy a series of test cases such as overvoltage events, overload events, reverse power flow events, etc.



Schneider Electric and EPRI used labs in the ESIF to demonstrate communication technologies for distributed energy resources as part of the INTEGRATE project. *NREL 41095*

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

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Partner with us

The ESIF provides a unique, integrated energy systems platform on which our academic, industry, or laboratory partners can work with a team of specialized scientists and engineers to identify and resolve the technical, operational, and financial risks of integrating emerging energy technologies into today's energy environment. Bring us your biggest energy system challenges, and let's solve them together.

Contact the ESIF User Program at 303-275-3027 or **userprogram.esif@nrel.gov** to discuss opportunities.

Learn more about the ESIF and see a list of current partners at **www.nrel.gov/esif/partners.html.**

For complete details on the ESIF's capabilities, tools, research focus areas, and user facility opportunities, please visit **www.nrel.gov/esif.**

The research setup uses the ESIF's solar photovoltaic simulator and connected devices in the Systems Performance Laboratory. To prove interoperability with a variety of devices and loads, the EPRI CIC is being tested with vendor-supplied devices that employ a number of communication standards, including DNP3, CEA-2045, IEC61850-90-7, OpenADR, and messages based on the Common Information Model (using a forthcoming standard, IEC 61968-5 Distributed Energy Optimization).

The project is specifically examining how the EPRI CIC can handle four situations:

- Managing voltage levels on a distribution feeder;
- Protecting grid and customer assets from overload and underload events;
- Interacting with a HEMS through a transactive platform, which can send pricing signals and set operational objectives and constraints for the distribution system; and
- Providing reactive power support for inductive loads such as motors and transformers, to enable the transmission grid to operate effectively.

The project is one of five partnerships NREL is managing under the Integrated Network Testbed for Energy Grid Research and Technology Experimentation (INTEGRATE) project, which aims to enable the nation's electric grid to handle increasing amounts of renewable energy. INTEGRATE is a $6.5-million, cost-shared project between the U.S. Department of Energy and industry partners that aims to allow renewable energy systems and other clean energy technologies to be connected to a smart power grid in a "plug-and-play" manner, similar to how computers automatically connect to new devices plugged in by the users. INTEGRATE is part of the U.S. Department of Energy's Grid Modernization Initiative.

With renewable energy expanding at all scales, new tools and technologies are needed to enable the grid to handle high penetrations of these renewable energy systems, particularly the smaller systems installed on utility distribution feeders as distributed energy resources. To address this need, NREL is managing five partnerships under the Integrated Network Testbed for Energy Grid Research and Technology Experimentation (INTEGRATE) project. See the NREL news release on INTEGRATE at: http://www.nrel.gov/news/press/2015/18515. *Photo from istock 514327842*

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