NEW STRIDES IN ENERGY INNOVATION
through public power’s only research and development program
2014 DEED Projects
The American Public Power Association’s Demonstration of Energy & Efficiency Developments (DEED) is the only research and demonstration program funded by and for public power utilities. Established in 1980, DEED supports and demonstrates research, funding, and education to improve the operations and services of public power utilities.

In this brochure, you’ll get an overview of DEED-funded projects completed in 2014 that have helped public power utilities increase efficiency, reduce costs, investigate new technologies, offer new services, and improve processes and practices to better serve customers.

DEED members may learn more about all DEED projects through the searchable online DEED Project Database at www.PublicPower.org/Deed (look for Project Database in the top menu). An index of all DEED projects completed since the program’s inception is also included within the DEED Project database. Use your APPA username and password to log into the database. If you don’t already have an APPA password, follow the prompts to create one. For help, email info@PublicPower.org.

DEED members may attend webinars on DEED projects at no cost and may also access recordings of past DEED webinars at www.PublicPower.org/DEED (look for Webinars in the top menu). Members may also buy books, DVDs, toolkits, or software created from DEED projects at a discount at www.PublicPower.org/Store.

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ENERGY EFFICIENCY

G-309

Healthy Energy Sustainable Home Building Practices
Nebraska Public Power District; Grant: $12,500

This project demonstrated best practices in the design and construction of a high-efficiency home and educated homeowners and contractors. The project addressed some concerns among the construction trades about cost, labor, feasibility, and sustainability of energy efficiency techniques in home building. The project helped to shift homeowner buying priorities from mere aesthetics to other benefits like health, comfort, long-term durability, as well as energy and cost savings. Key components of the construction process were filmed and edited into an educational video with an instructional flyer. Healthy Energy Homes, a toolkit with a full-color brochure and 21 videos provide homebuilders with tips on cost-effective energy-efficiency practices to make new homes comfortable and healthy.


DISTRIBUTION & SYSTEM IMPROVEMENT

G-310 – G-319

DEED Board, American Public Power Association; Grant: $90,000

DSTAR is a consortium of electric utility organizations that sponsor pragmatic research to be applied to everyday system design, operation, and maintenance. Research includes equipment testing and product evaluation, niche software for standards and engineering support, and white papers and reports on pressing industry issues. DSTAR bundles multiple research projects into a “program” that typically lasts 1.5 to 2 years.

G-310, Project 13-2
Commercial Load Estimation Program
Southern Company's iCLEAR (Industrial and Commercial Load Estimating and Referencing) system is available for licensing to DSTAR members. The DSTAR project has validated regional iCLEAR models, based on a proprietary method developed by Z Solutions, using DSTAR member facility data. This project implemented the models in iCLEAR to estimate commercial loads in different regions of the country.

G-311, Project 13-3
Inspection and Maintenance Survey
This project identified best practices in inspection and maintenance and use of thermal imaging devices, assessing how often utilities do maintenance on reclosers, regulators, and other critical assets. The project explored how often inspection is performed, what gets inspected, observed failure rates for various assets, what type of inspection is actually being done, and the results and lessons learned.

G-312 Project 13-4
Secondary Electrical Design Software (SEDS) Enhancements
The Secondary Electrical Design Software (SEDS) enables users to easily lay out a secondary design and assess performance measures, such as voltage drop, flicker, loading, and short circuit current using a customized load flow algorithm. This project developed improvements to the SEDS three-phase load database — user interface enhancements, bulk editing and importing of data, and handling of seasonal coincidence factors.
**G-313, Project 13-5**  
**Harmonic Load Impact and Mitigation**

The nature of the aggregate electrical load served by U.S. distribution utilities has changed to more non-linear loads, which can cause harmonic current and voltage distortion. This project created a comprehensive guide on the effects of excessive harmonics on the distribution system and conducted a case study where excessive third harmonic currents on a distribution feeder were mitigated by converting the capacitor banks on the feeder from “grounded wye” to “floating wye.”

**G-314, Project 13-6**  
**Centralized vs. Distributed Feeder Automation**

Utilities have been implementing distribution automation programs to improve reliability and operational efficiency through monitoring and control of field assets. This project compared the advantages and disadvantages of centralized versus distributed feeder automation schemes. The project report provides an overview of the technical issues around DA architecture and relates the needs of particular DA applications to communication needs and architecture impacts.

**G-315, Project 13-7**  
**Conservation Voltage Reduction: Testing, Methods, and Results**

With the emergence of smartgrid technologies, utilities are using conservation voltage reduction to reduce peak demand, energy delivered during high-cost periods, and overall energy demand. This project assessed the effectiveness of CVR on various circuits, and the tradeoffs between feeder investment and CVR performance. A detailed benefit/cost study of five representative feeders is documented in the project report to quantify the cost-effectiveness of CVR implementation, including load balancing, fixed and switched capacitor banks, voltage regulator application, and control strategies from basic local control to advanced centralized control.

**G-316, Project 13-8**  
**SEDS-based Lighting Tool**

This project developed SEDS Light, a Secondary Electrical Design Software-based tool focused exclusively on lighting applications. To create SEDS Light, this project stripped unused functionality from the SEDS application, reduced load choices, simplified load selection, and updated voltage drop calculations for lighting. It allowed applications of up to four lights, a pole and connections from “load-to-load,” without the need for a node in between.

**G-317, Project 13-9**  
**PV Impact on Distribution Systems**

Distributed photovoltaic generation can pose significant challenges to distribution system design, operations, and power quality. This project produced a comprehensive report on grid-connected PV systems and how utilities can avoid excessive system impacts of distributed generation. The report focuses on small residential rooftop and backyard installations (less than 10 kW), commercial behind-the-meter applications (10 kW to 1000 kW), and wholesale power generation plants or “solar farms” connected at the distribution level (less than 20 MW).

**G-318, Project 13-10**  
**Smart Grid Impact on Distribution Reliability**

Smartgrid projects that include some form of automated feeder switching have demonstrated the potential to improve distribution reliability, with reported reductions in System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI) of as much as 50 percent. But not all circuits are created equal. And each level of improvement comes at a cost. This project explored which circuits are most likely to see the best return on incremental distributed automation investment and the level of automation that is likely to be appropriate for circuits of different types.

**G-319, Project 13-1**  
**Software Updates for Windows**

DSTAR has produced a range of software tools that members use extensively, even as execution environments and operating systems continuously evolve. As many operating systems were upgraded to Windows 7, DSTAR members wanted to learn how to update their software tools for usability and compatibility. This project surveyed DSTAR members and selected the three to four most commonly used tools for extensive testing and verification in the Windows 7 environment. Issues related to installation and execution were resolved, and updates of the software tools were produced and distributed to DSTAR members.
ENERGY EDUCATION
G-320
The Energy Edutainment Experience
Lincoln Electric System, Nebraska; Grant $2,500

Lincoln Electric System evolved the Energy Edutainment Experience to educate and engage customers and community stakeholders. A special energy efficiency gaming presentation was developed and is offered by utility staff at various community forums and exhibitions. The presentation asks simple questions — what is the season and time of day for peak electricity demand, what temperature should you set your thermostat in winter, etc. — with multiple choice answers. LES provides remote interactive feedback devices to the audience members to allow them to answer the questions. LES has also used the gaming presentation to train its own staff to better serve customers calling to ask about energy efficiency.

POLE ATTACHMENTS
G-321
APPA Pole Attachment Workbook
DEED Board, American Public Power Association; Grant $10,000

APPA’s Pole Attachment Workbook offers guidelines for public power utilities on pole attachment fees and rate methodology; the permit process; treatment of overlashing; ducts and conduits; wireless attachments; jointly owned poles; and special treatment for schools, government units, and private networks. The workbook includes a model pole attachment licensing agreement and an Excel-based calculator to determine rates. The 2014 edition presents changes to the Federal Communications Commission’s pole attachment rules through the April 2011 Pole Attachment Order. While municipal utilities are exempt from the order, they need to understand the changes to effectively negotiate with telecommunications and cable attachers. Order at www.PublicPower.org/Store.

ENERGY EDUCATION
G-322
E-Tracker: Tracking Daily Electric Energy Use and Weather Data
ElectriCities of North Carolina, Inc.; Grant $21,000

ElectriCities’ E-tracker is a hands-on energy education project that taught students and their families to “measure it to manage it.” E-tracker was deployed through science teachers in eight middle and high schools in public power communities. Students learned to apply linear regression and other techniques to determine the relationship between temperature and electricity use at home. They recorded daily meter readings in their homes for 30 days, plotting them against average daily temperatures. They analyzed electricity bill history for 12 months and found that the peak use could be two to four times as much as the baseline average use. Students enjoyed the responsibility of checking meters, understanding what impacts energy use, and working with their families.

SOLAR, ENERGY STORAGE
G-323
Integrated Vehicle Energy Storage and Solar Project
North Carolina State University; Grant $48,000

North Carolina State University researchers designed and installed a single integrated system to generate solar PV, charge electric vehicles, store energy up to 20 kWh, connect to the local microgrid, and educate the public about intelligent energy management. The Vehicle Energy Storage and Solar Demonstration designed, built, and operated a solar powered electric vehicle charging station (capacity for 10 chargers), coupled with an energy storage system, in the parking deck of the university’s Keystone Science Center. The system is tied to the 12.4-kV Green Energy Hub microgrid at the university. An LCD touchscreen is mounted to the parking structure to monitor energy generation and flow between components in real time, and to educate visitors. The system integrates several advanced energy technologies and serves as a test bed for intelligent integration of renewable generation and storage within microgrids.

ENERGY EFFICIENCY
G-324
The True Green House
Piedmont Municipal Power Agency and City of Clinton, South Carolina; Grant $40,000

The True Green House Project consisted of a case study on renovating older homes to improve energy efficiency. Piedmont and the city of Clinton developed web-based tools to help homeowners prioritize renovations for maximum savings. The tools offered links and resources on the environmental impact of planned renovations. True Green included a refrigerator tool, solar panel tool, water heater tool, light bulb tool, and household heat flow tool. Each of these tools compared two systems — the current system and the one the homeowner was planning to switch to — measuring the related financial impact of the renovation/replacement factoring in local weather and environment, home temperatures and conditions, etc. Unfortunately, the software developed for this project has glitches and cannot be fixed without significant outlay of time and money.
ENERGY EFFICIENCY
G-325
Municipal Financing of Customer Energy Projects
Burlington Electric Department, Vermont;
Grant $34,250 (Phase 1), $4,800 (Phase 2)

The Burlington Electric Department collaborated with energy efficiency advocates statewide to secure legislation enabling municipal financing of energy efficiency investments. Owner-occupied residential customers can borrow up to $30,000 for BED-approved energy efficiency — thermal and electric — and renewable energy projects. The repayment fee will appear monthly on the BED electric bill for the term of the assessment, which can be up to 20 years in many cases. Based on its experience, BED has produced a manual describing how municipalities can allow property owners to finance energy improvements and solar additions through property taxes. The manual offers a program design, flow chart, and sample documents. An appendix outlines the program design process and implementation path. The manual includes user profiles and implementation lessons.

SOLAR, ENERGY STORAGE, MICROGRID
G-326
Community Energy Storage Incorporating Renewable Resources
City Utilities of Springfield, Missouri; Grant $75,000

City Utilities of Springfield in Missouri designed, built, and commissioned an energy storage project connecting four solar-powered homes. CU installed a system to support solar generation and allow for the monitored sharing of energy between the four houses while exporting excess energy to energy storage battery racks for use in load shedding, load shifting, and temporary islanding. Two A123 lithium ion battery racks — with 960 VDC nominal voltage, and roughly a 30 kWh storage — were used in this project as the main source of storage capacity. Critical connections were made between the panel boards of the four houses; the solar arrays of the homes; the communication, monitoring and control devices; as well as the Bi-Directional Inverter and the battery racks. A single interconnection point to the municipal grid was established, with the controls and islanding disconnects necessary to preserve line safety.

SOLAR, THERMAL
G-327
Combination Concentrated Photovoltaic and Solar Thermal Array System for Distributed Generation
American Municipal Power, Inc, Ohio; Grant $45,000

American Municipal Power, Inc. partnered with a member, Cleveland Public Power, on a project to test, in real time, a dual technology system designed to produce photovoltaic electric energy and efficiently use waste heat at the same time. The project was intended to meet the needs of customers that use electricity and substantial amounts of heat or hot water — laundries, car washes, fire stations, indoor swimming pools, etc. Along with electricity from solar power, the dual technology system was designed to provide substantial heat/hot water at no additional cost. A site at a greenhouse in Cleveland was selected. The greenhouse site was cleared and a field of 20 solar arrays, each of 1.5 kW, was erected in 2011. PV energy was tied to the grid, and a thermal loop was installed to direct the thermal energy from the field to the greenhouse, where a heat exchanger was installed. The equipment vendor and contractor, GreenField Solar was not able to devote resources to make the system work and AMP closed out the project in 2014. AMP recommends that if an entity wants to get the benefit of both PV energy and solar heat, the most effective option at this time would be to install two separate systems — one solar PV and one solar thermal.

LIGHTING
G-328
The Potential Effects of Increasing Use of Solid State Lighting with Lighting Controls
Silicon Valley Power, California; Grant $65,000

While utilities recognize the benefits of SSL for energy efficiency, they may have concerns about potential effects of dimmable LEDs on their distribution system or concerns about metering and billing accuracy. Silicon Valley Power studied the effects of dimmable SSL on utility systems focusing on three aspects — metering and billing, harmonic effects on power quality, and possible impacts on power system stability. The project found that LEDs are not a constant load and that the power consumption is reduced when dimmed just as is the case with incandescent lamps. The harmonics produced by the lamp/dimmer combinations were unlikely to result in significant meter errors. SVP also determined that LEDs do not pose an issue for power system stability, SVP’s project demonstrated that utilities have no major disadvantages in promoting the use of LEDs with controls.
SCHOLARSHIPS

**S-169**
**Leveraging Smart Meter Data for Near Real-Time Residential Energy Audits**
City of Princeton Electric Department, Illinois

Abiodun Iwayemi, a student at Illinois Institute of Technology, used non-intrusive load monitoring to inform customers about their energy use. NILM disaggregates meter readings, yielding energy consumption data for individual appliances.

**S-170**
**Apply Non-intrusive Load Monitoring Technique to Family Electricity Bill Interpretation**
Marietta Power and Water, Georgia

Georgia Institute of Technology student Dawei He designed an inexpensive residential energy auditing device that can provide near real-time electricity consumption information to help homeowners use less energy and save.

**S-171**
**Introduction to Electrical Engineering Intern**
Idaho Falls Power, Idaho

Brigham Young University student Austin John Tew was introduced to electrical engineering in the utility industry. He was assigned a design project to upgrade a 161kV substation under the mentorship of a staff electrical engineer.

**S-172**
**AutoCAD Engineering Analysis**
Loveland Water & Power, Colorado

Daniel White, a student at Colorado State University, helped to implement the engineering analysis feature of the AutoCAD Utility Design software. This feature enables analysis of distribution design as AutoCAD drawings are created to ensure that the design meets all engineering and system requirements.

**S-173**
**Advanced Power Strip Field Testing & Energy Savings Verification**
Silicon Valley Power, California

Brent Kawamura from Santa Clara University helped in research to test and verify the energy savings potential and user acceptance of Tier II Advanced Power Strips.

**S-174**
**Analysis of a Solar Inverter System for Frequency and Voltage Regulation**
Platte River Power Authority, Colorado

Mohit Chhabra, University of Colorado, Boulder, developed a load-frequency based electric grid model for frequency stability and regulation analysis; a transient level electric grid model for voltage stability and regulation analysis; and voltage and frequency control algorithms for a solar inverter system. He analyzed economic savings for a grid tied solar-battery generation system.

**S-175**
**Airborne Portable Electric Generation and Storage Universal System**
Tacoma Power, Washington

Alexander A. Anderson, a mechanical engineering student at Saint Martin's University, evaluated the advantages and cost-effectiveness of an airborne electric generation system integrating wind energy augmentation and advanced photovoltaic arrays.
S-176
Set Point Adjustment Strategy for Mitigating Transients in a Microgrid System
Tacoma Power, Washington
Christopher Stone, a Washington State University student, explored a strategy for mitigating transients in a small-scale power system that was operating near its operational limits. The concept is called set-point automatic adjustment with correction enabled (SPAACE).

S-177
Distributed Control Strategy for Microgrids
Seattle City Light, Washington
The ability to control and manage grid facilities is of paramount importance, but it poses a significant challenge because centralized control schemes will become strained under significantly increased computational factors. Washington State University student Mehrdad Yazdanian assisted with a distributed control strategy for the smart grid, examining ways to divide the control task among different units.

S-178
Integration of Solar PV into Rooftop Communities
Iowa Association of Municipal Utilities
Iowa State University student, Jordan Vaughan, helped integrate solar PV into Iowa public power communities. His work augmented a DOE-funded “Rooftop Solar Challenge II” project for Iowa communities to reduce the soft costs of solar installation. Vaughan helped evaluate and remove community barriers to solar installations.

S-179
GIS and Meter Management
Rochelle Municipal Utilities, Illinois
Debbie Van Sickle, student intern from Northern Illinois University, worked in the area of GIS mapping and attribute management of electrical and water meter data for optimization of meter replacement tactics and meter read route management for resource efficiency in an area of reduced personnel resources.

S-180
Digital Rooftop Unit
Omaha Public Power District, Nebraska
Laura Schwartkopf, a student at University of Nebraska at Omaha, helped Omaha Public Power District with its Digital Roof Top Unit (Digi-RTU) pilot project. The intent was to help, commercial and industrial customers run HVAC rooftop units more efficiently with an after-market optimizer and helped participating customers receive additional incentives.

S-181
Small Modular Reactor Project
Tennessee Valley Authority
Dakota Huddleson, a student at University of Tennessee at Chattanooga, worked on the Clinch River Small Modular Reactor Project to help improve safety and security, reduce construction time, increase standardization, decrease site size and create more site options, and lower financing costs for nuclear reactors.

S-182
Assessing the Impact of Plug-In Electric Vehicle (PEV) Charging on Transformer Loading
City Water, Light & Power, Springfield, Illinois
Saurav Mohapatra, a Ph.D. student in Electrical and Computer Engineering at the University of Illinois focused on the estimation of distribution transformers’ loading (or likelihood of overloading) and provided recommendations to sustain a higher ownership of plug-in electric vehicles.

T-12
Tool to Analyze Power System Security Under Hurricane Threats
University of Texas, Austin, Texas
Yezhou Wang, a student at University of Texas at Austin, worked on constructing an analysis tool that will use existing irrigation probabilistic hurricane models and cascading outage models to perform power system safety and security analysis and provide suggestions on utility infrastructure upgrades and storm-hardening measures.
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