College and Industry Collaborate To Make Microgrid Network a Reality

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AN EMERGING TECHNOLOGY IN BUILDING POWER distribution involves the use of a room ceiling tile support grid to create a low-voltage "microgrid" network. With this network, 24-volt DC power is routed throughout the room via conductors embedded in the drop-ceiling support structure. Users can then tap into the low-voltage supply from any location in the room.

The microgrid effort is organized by a consortium of industry and university partners exploring the use of low-voltage DC indoor power distribution for a variety of commercial, industrial, and residential applications. An example of applications on the load side includes lighting and ventilation devices. Input power for the microgrid can be derived from many sources including standard building AC power and alternative sources such as solar.

At Penn State Berks, a 24-volt DC ceiling system was installed in the Engineering Automation Lab of the Gaige Technology and Business Innovation Building. The room serves as both research and classroom space. Engineering technology students are involved with an innovative and emerging technology in the area of indoor building energy distribution. With the help of industry partners of the EMerge Alliance® consortium, an engineering laboratory/classroom has been converted to use a 24-volt DC system to power its lighting needs.

The 24-volt DC power is distributed throughout the room via conductors embedded in the support grid of the suspending ceiling system. The ceiling system used in the room is manufactured by Armstrong World Industries, Inc. Other members of the EMerge Alliance® consortium manufacture equipment to support the low-voltage DC power distribution, control, and use of the microgrid. End users can obtain power for their devices by simply connecting to the suspended ceiling grid, either below or above the ceiling tiles, at the point of use in the room. The ease of use and inherent safety of the low-voltage system make it useful for engineering student projects.

The main purpose of installing the low-voltage system was to provide students with an area to experiment with their own ideas and designs for the type of devices that should be used in this environment. Students in the engineering technology programs have been involved with designing and fabricating devices to use and/or control power derived from the 24-volt DC microgrid system. Devices include room lighting control and portable device charging stations. The low-voltage microgrid provides a relatively safe environment in which to experiment with new devices for occupied space environmental control. Students are extremely motivated

"Working on the microgrid project was an eye opener to me. As a student, I am there to bridge the project to an understanding at the student level. I am learning all of the various software used on this project and am able to consult with others so I can begin to understand the true nature of the world of engineering."

– Kory Boltz, first-year engineering student

to create devices that positively influence their learning environment.

The microgrid will be partially powered via roof-mounted solar panels. Five 230-watt solar panels have been donated by Canadian Solar, Inc. These solar panels will be installed in an array to be mounted on the roof of the Gaige Building. Conduit was installed from the roof of the Engineering Automation Lab at the time the building was constructed in anticipation of this project.

Nextek Power Systems has also provided a Maximum Power Point Tracking (MPPT) regulator to condition the solar array output power prior to being applied to the microgrid via the Power Server Module (PSM) auxiliary input. The PSM will provide the additional energy from the AC mains input if the microgrid load exceeds the energy available from the solar array. The status of the PSM power flow can be monitored via a Zigbee link and the accompanying software.

"Penn State Berks has put together an impressive group of companies to help advance this promising area of more energy efficient and flexible DC direct power systems. RER Energy Group has seen prices of solar equipment drop dramatically over the past three years. Now, as LED lighting and other DC-based equipment start to follow similar cost decline profiles, attractive applications for DC microgrid systems are rapidly expanding. RER is glad to be part this team and lead the solar integration aspect of the project."

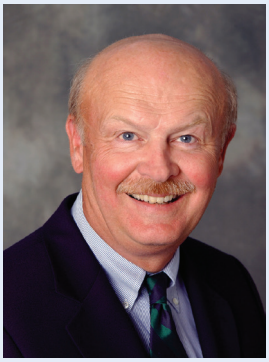
– Jim Kurtz, President of RER Energy Group

Energy storage via batteries will be incorporated into the system. The capacity of the battery array is still being determined by the manufacturer and corporate partner, East Penn Manufacturing, Inc., manufacturer of Deka® batteries. A charge controller for the batteries is also being developed by Ecoult, Inc., a subsidiary of East Penn Manufacturing.

Faculty and students will work together on the energy storage phase of the project. Hardware and software will be developed to schedule and control the flow of energy from the solar array to the batteries and the room load. Various load/charge management profiles will be investigated to better understand how battery storage can be most efficiently utilized in microgrid installations.

We would like to thank the industry collaborators involved for their contributions of material and/or time in creating the low-voltage "microgrid" network at Penn State Berks.

- Armstrong World Industries, Inc.
- Canadian Solar, Inc.
- East Penn Manufacturing Co., Inc.
- Ecoult
- EMerge Alliance
- Nextek Power Systems
- Off-Grid Technologies
- ONExia, Inc.
- Parker Hannifin Corp.
- RER Energy Group
- TE Connectivity



MESSAGE *from the* CHANCELLOR

As Pennsylvania's land-grant university, Penn State's mission encompasses three core priorities: teaching, research, and service. Here at Penn State Berks, we stress the outstanding quality of teaching and learning at the college, made possible by our talented faculty who are dedicated to student success, and we also encourage and expect faculty engagement in research and service as well.

On occasion, questions are raised about the role and importance of research and scholarship at an undergraduate college such as Penn State Berks. Just what is the relationship between teaching and research? Must those two priorities compete with one another, or are there important ways in which they can complement?

My response to these questions is that indeed both are important for the primary reason that we are a learning community that is framed around the core value of curiosity. And as you will discover in this issue of our *Research* magazine, curiosity is alive and thriving at Penn State Berks!

Take a close look at the range of questions that drive the curiosity of students, faculty, and staff who are highlighted here. From Professor Bob Forrey's research on the origins of the Universe, to Professor Edwin Murillo's study of Existentialism in Latin American thought, there is richness and depth to the questions that are being asked and explored. Then add in Dr. Bert Eardly's study of the evolution of rhizobia and Professor Ken Fifer's cross-disciplinary exploration of the connections between architecture and poetry, and one begins to get a sense of the exciting questions that our colleagues are raising and exploring. Curiosity is indeed alive at Penn State Berks. Explore as well the articles that highlight collaborations between the college and our corporate, business, and school partners that are representative of the exceptional service which our faculty, staff, and students provide to the community.

R. Keith Hillkirk

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