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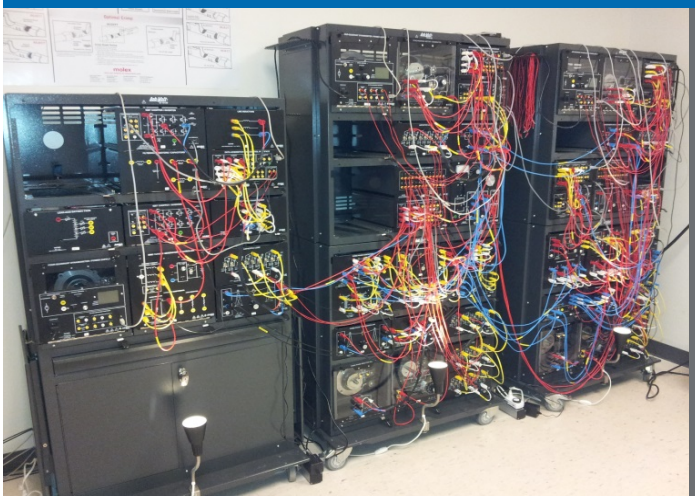

Upgrading Power and Energy Engineering Education: Setting up a Lab to Train Smart, Green-Power Engineers

SPOTLIGHT ON…

TCNJ THE COLLEGE OF NEW JERSEY

- Public, Coeducational University
- Website: www.tcnj.edu
- Located in Ewing, New Jersey
- Established in 1855
- Total enrollment: 6,900
- TCNJ School of Engineering: 500 undergraduate students
- Project: $100K primarily financed by a grant
- Main SEPS lab supplier: Lab-Volt

Anthony Deese, Ph. D. Assistant Professor of Electrical Engineering, Director of TCNJ Smart Electric Power System Laboratory (SEPS)

A NEW ADVANCED LAB FOR A POWER ENGINEERING PROGRAM

Most Western countries now face the **challenge of modernizing an aging grid infrastructure in a field where the workforce is rapidly aging**. Green, smart-power energy programs that support growth while respecting the environment are on many government agendas. Colleges and universities are key to creating a pipeline of qualified power and energy technicians and engineers.

Dr. Anthony Deese, Assistant Professor at The College of New Jersey (TCNJ), is well aware of this issue. "As a graduate student and post-doctoral researcher, I worked with the Interconnected Power System Laboratory (IPSL) and Reconfigurable Distribution Automation and Control (RDAC) Laboratory at Drexel University. Upon making the transition to TCNJ in 2010, **I realized how important an advanced power laboratory would be to my success**. Because of the cost and space limitations at a smaller institution like TCNJ, I formulated the **idea of a lower-voltage smart grid – one that focuses on use of innovative technologies over large power flows**."

This is when the idea of a Smart Electric Power System (SEPS) laboratory emerged, aimed at supporting TCNJ's growing power engineering program.

SUBMITTING THE PROJECT FOR FUNDING

To finance the creation of this SEPS Lab, Dr. Deese decided to submit a project proposal to the **National Science Foundation, which was accepting project proposals under its Major Research Instrumentation Initiative**. To secure funding, Dr. Deese had to carefully plan his project.

The objective of the SEPS Lab was twofold:

1. Outline techniques that faculty researchers and smaller, undergraduate institutions may employ to **develop a practical yet effective power engineering laboratory**.
2. Create a laboratory **addressing emerging technologies** to ensure its relevance in the modern engineering world.

Configuration of Smart Electric Power System (SEPS) Laboratory, Armstrong Hall, TCNJ, in September 2012.

WHICH TECHNOLOGIES MUST A SEPS LAB INCLUDE?

To ensure the SEPS Lab met the second part of its objective, Dr. Deese listed the technologies that had to be included:

- **Remote Measurement and Control** – One primary characteristic of a smart grid is the presence of digital technology to facilitate remote measurement, communication, and control of power system components.
- **Power Electronic Converters** – The presence of power electronics in transmission and distribution systems has grown drastically, primarily due to reduced cost.
- **Direct Current Transmission** – Europe's power grid contains almost 30 high-voltage direct-current transmission links. The technology becomes increasingly popular with that of power electronics.
- **Renewable Power Generation** – Generation of electricity from renewable energy sources is one of today's most relevant engineering topics.
- **Grid-Connected Energy Storage** – The utilization of bulk energy storage in electric power systems is limited, predominantly because of high cost. However, this technology has the greatest potential to revolutionize how electricity is generated, transmitted, and consumed.

THE THREE DESIGN PRINCIPLES

The success of the project relied on the following design principles:

- **Robust and versatile**: The laboratories of undergraduate institutions must be facilitate the study of introductory as well as advanced topics, and be versatile enough to be operated by novice as well as experienced engineers.
- **Cost/Space efficient**: Smaller institutions are often most sensitive to funding and space limitations; the laboratories must provide significant research and teaching benefits with conservative requirements.
- **Commercially-available**: The construction and testing of custom hardware requires time and effort; faculty researchers can turn to vendors to benefit from their expertise and support.

Having previously worked with Lab-Volt's training systems during his studies, Dr. Deese knew that the quality, flexibility, and wide range of solutions would fit his needs. He contacted Educational Solutions Enterprises, a partner in Lab-Volt's sales network.

To create the lab layout and select the right equipment, Dr. Deese teamed up with Lab-Volt engineers. **Together they created a powerful, customized lab that answered all of Dr. Deese's requirements by combining various modules** and components from existing power energy training systems to recreate the behavior

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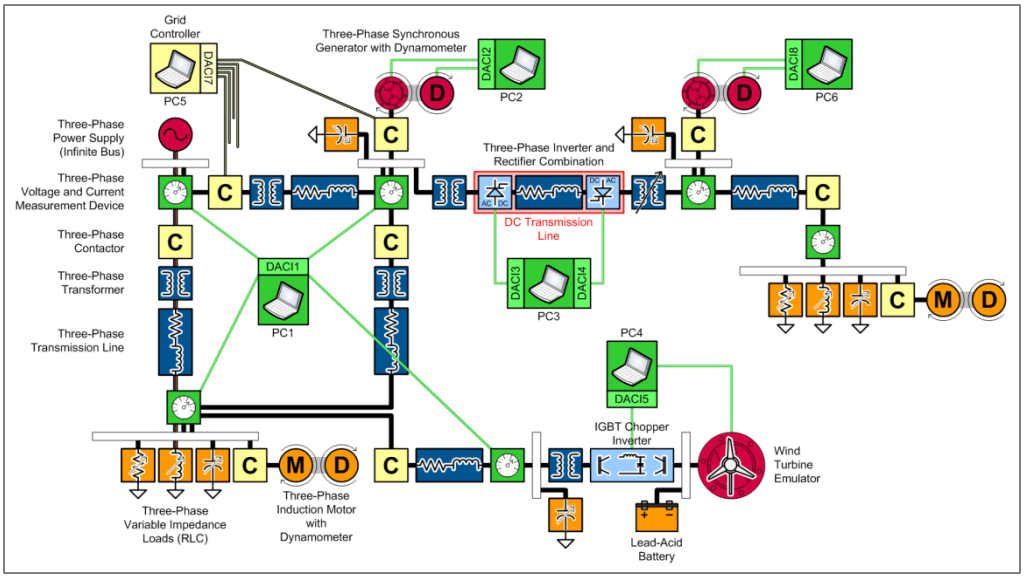
of an actual grid. This setup is also reconfigurable, i.e., all the components can be rearranged for further experiments as the connections are not fixed.

The project was submitted and ultimately approved by the National Science Foundation. The equipment was then purchased and installed on TCNJ premises in September 2012. The following figure illustrates the final schematics of the lab:



SEPS Lab – Nominal Configuration (Click to Enlarge)

A ONE-OF-A-KIND LAB FOR STUDENTS AND RESEARCHERS

During its first year of use, the SEPS lab was mainly used for the Power Systems and Renewability course. It is now an **essential part of the learning process**, as nothing can replace hands-on learning. It **lets researchers manipulate the parameters and topology of a power system and observe the effects** of their actions, thus enabling them to do innovative work aimed at **addressing the growing global need for smart energy conversion, distribution, and utilization**.

"The lab has exceeded my expectations. I am proud of the fact that it is 'one of a kind,' one type of advanced power laboratory that even larger institutions do not have access to", says Dr. Deese.

The SEPS Lab also increases TCNJ influence. "Many large ECE programs in the United States support advanced power engineering laboratory facilities, facilitating innovative energy research and student understanding. **The SEPS Laboratory allows TCNJ faculty, students, and researchers to capably work alongside colleagues from larger institutions**."

For more information about the SEPS Lab, visit www.anthonydeese.com or watch a video presentation.

What's in the SEPS Lab?

The comprehensive lab equipment is based on Lab-Volt's Electric Power Technology Training Program (Series 8010). LVDAC-EMS software supports monitoring and control. See Lab-Volt's offering for Smart Grid (PDF) for more details.

Emerging smart grid technologies encompass photovoltaic cells, wind turbines, battery storage, power electronic converters, transmission lines management, remote control of the grid, generators, automatic control, and embedded data acquisition/control capability.

If you need help designing a custom lab project, contact our team.

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