Power Systems Protection Laboratory through University-Industry Partnership

Peter Idowu, Ph.D., P.E.
Assistant Dean for Graduate Studies
Associate Professor of Electrical Engineering
Penn State University - Harrisburg
idowu@psu.edu
Introduction

• The 2007 National Science Foundation workshop on “The Future Power Engineering Workforce”
• Process for partnership and collaboration with regional utility company
• Goals and strategy for developing the protection lab
• Student-Initiated Learning Modules
• Plans for other Innovative Modules
2007 National Science Foundation workshop

• “The Future Power Engineering Workforce” convened of participants from government, academia and industry
• Group identified key drivers of the projected future shortage of power engineering graduates
• Recognized lack of university support power engineering programs
• Persisting poor image of the power engineering field
• Some irrelevance in the higher education experience in relation to professional practice

• One of several recommendations is to build “strong and ongoing industry relationships with universities to enhance educational programs” and to support faculty teaching initiatives
Process for partnership and collaboration

- Periodic visits to utility substations
- Employment of graduates from the power program
- Representation of utility industry on the EE technical advisory board
- Review of power engineering curriculum for relevance
- Visits to assess laboratory environment
- Creation of equipment layout plan and solicitation of vendors to support initiative
- Delivery of equipment by vendors and training for students
- Setup and development of digital training modules
- Inclusion of instruction resources from utility into power systems coursework
- Commitment of funding from utility partner to continue innovation
Goals and strategy for developing protection lab

- Creating a learning environment that projects an image of the future power engineer
- Making the higher education experience relevant by integrating current industry practices
- Making education more interesting by engaging students collaboratively
- Building strong and ongoing partnership with the industry
Student-Initiated Learning Modules

• RTU (SEL 3530-RTAC) / Relay configuration and development of basic substation HMI
• RTU (Novatech Orion LX) interfacing to SCADA meter and relays, and remote control of substation through Orion LX webserver HMI
• Voltage management and utility economics using ETAP
• Protective device coordination using ETAP STAR
Intro to Module 1

Penn State Harrisburg

Substation Automation Learning Module Series

SEL RTU—Relay Configuration & HMI (Human Machine Interface) Development
HMI for Orion LX RTU for substation automation
## Process matrix for setting engineering objectives

<table>
<thead>
<tr>
<th>Requirement Statement</th>
<th>Function and Application objectives</th>
<th>Communications Protocols</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A.1</strong> The system should automate data acquisition on a minimal number of platforms.</td>
<td>Use M650 (SCADA Meter), M571 (SER-Sequence of Event Recorder), for metering of voltage, current and phasors. Derive real and reactive power and system frequency</td>
<td>IEC 61850, DNP3, Modbus, SEL. Ethernet, Serial EIA232/485</td>
</tr>
<tr>
<td><strong>A.2</strong> The system should employ a user-friendly automation and control interface that also provides complete system situational awareness.</td>
<td>Create HMIs for interaction with power system using Novatech and SEL web servers.</td>
<td>TCP/IP</td>
</tr>
<tr>
<td><strong>A.3</strong> The system should provide the ability to simulate digital relay operation without the generation of actual power system fault currents.</td>
<td>Use SEL – 387, SEL – 751A, SEL – 421 to set up remote trip/close control of CB via web based HMI</td>
<td>TCP/IP, IEC 61850, DNP3, Modbus, SEL. Ethernet, Serial EIA232/485</td>
</tr>
<tr>
<td><strong>A.4</strong> The system should use interactive instruction methods that quickly bring students up to speed on the various software and hardware platforms.</td>
<td>Use CamStudio and Powerpoint to create learning modules and tutorials</td>
<td></td>
</tr>
<tr>
<td><strong>A.5</strong> The system should provide electrical isolation from primary currents and voltages for safety.</td>
<td>Use CTs and PTs for current and voltage scaling</td>
<td></td>
</tr>
<tr>
<td><strong>A.6</strong> All system RTUs (Remote Terminal Units) shall be able to integrate multivendor IEDs (Intelligent Electronic Devices).</td>
<td>Use Orion LX, SEL3530 RTAC –Real Time Automation Controller) as polling data concentrators to demonstrate communication via multiple protocols</td>
<td>UCA, IEC61850, DNP, SEL, Modbus</td>
</tr>
</tbody>
</table>
Tasks addressed in learning Module #1

• Use of SEL 3530 RTAC as RTU
• Specification of communication protocols for devices, connection type, communication type, speed
• Setup of power system data input and calibration
• Use of acSELeerator to configure the RTU to poll data from devices for SCADA
• Setup of breaker control communication and trip code to operate circuit breaker
• Migrating data to RTAC-RTU
• Using Diagram Builder to design embedded web-based HMI
• Associating tags with icons
• User interaction with remote substation through HMI
Plans for other Innovative Modules

- SEL-3530 RTAC
- SEL-421
- SEL-387
- OrionLX
- SEL Protocol over RS232
- 12 kV Recloser
- Bitronics M571
- Bitronics M650
- Orion Distributed I/O