PowerCyber: Cyber-Physical Security Testbed Training for Smart Grid

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Cybersecurity for Smart Grid

Objective

The goal of the CPS security training is to provide practical scenario-based hands-on learning experience for the participants in cyber attack-defense methodology for smart grid using industry-grade SCADA platform and state-of-the-art security practices and tools.

Learning Outcomes

Outcomes

- Ability to identify and analyze attack vectors to the grid environment
- Ability to use modern cybersecurity tools for attack-defense such as network reconnaissance, vulnerability assessment, firewall configuration, intrusion detection/prevention.
- Ability to perform scenario-based Risk analysis
- Ability to perform impact characterization for cyber-attack scenarios

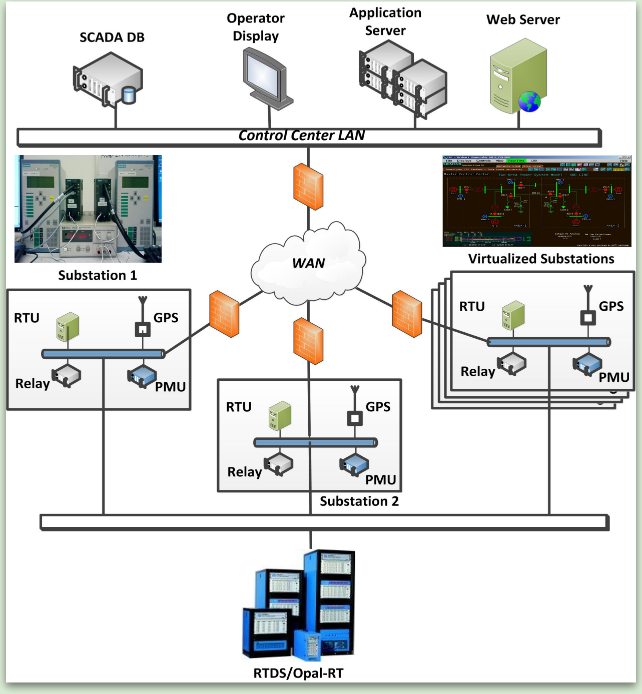
CPS Testbed-based Cybersecurity Training Platform

Usecases

- Cyber Attack-Defense Evaluation
- Vulnerability Assessment
- Systems Impact Analysis
- Security Product Testing
- Risk Assessment
- Risk Mitigation Studies
- Education
- Industry Short-Courses

Salient Features

1. **Hardware-in-the-Loop Real-Time Testbed for modeling smart grid**
   a. Industry-grade SCADA/EMS and Substation platform
   b. GNS3-based and ISEAGE-based WAN emulation; DNP3 and IEC-61850 SCADA protocols; Industry-grade cybersecurity software systems.
   c. Wide-area control and protection applications interfaced with Hardware-in-the-Loop (HIL) CPS Testbed including Opal-RT/RTDS.
2. **Scalability, Modularity and High Fidelity:**
   a. RTDS/Opal-RT provide ability to simulate large power systems with control and protection functions in real-time.
   b. Multi-area substation architecture enabled through virtualization.
   c. Testbed-based federation for smart grid applications.
3. **Remote Access:** Web-based access for remote experimentation with custom power/cyber system models and attack templates.



Basic CPS Security Training

Training Modules	Applicable NERC CIP Standards
Module 0: Introduction	CIP – 004: Personnel and Training
Module 1: Network Scanning	CIP – 0010: Configuration Change Management and Vulnerability Assessments
Module 2: Vulnerability Assessment	
Module 3: Attack Exercise – Relay tripping	CIP – 0010: Configuration Change Management and Vulnerability Assessments CIP – 0011: Information Protection CIP – 0012: Physical Security
Module 4: Defense: Firewall configuration	CIP – 003: Security Management Controls CIP – 005: Electronic Security Perimeter(s) CIP – 007: Systems Security Management CIP – 010: Configuration Change Management and Vulnerability Assessments
Module 5: AttackSurface Host Analyzer (AHA)	
Module 6: SIEM and IDS	
Module 7: Attack-Defense case studies	

Advanced CPS Security Training

Hardware-in-the-Loop CPS Training (WAMPAC and SCADA)
Module 11: Wide-Area Monitoring
Module 12: Wide-Area Damping Control
Module 13: Wide-Area Voltage Control
Module 14: Wide-Area Protection - Remedial Action Schemes
Module 15: Automatic Generation Control
Module 16: Distributed SIEM IDS for the Multiple Substations
Module 17: Scenario-based Attack-Defense: Ukrainian Power Grid 2015

Trainings Chronology	**Year**	2015/2016	2017	2018
	Industry Users	GridSecCon 2015, GridSecCon 2016, EPRC	MidAmerican Energy Company, CIPCO, Cedar Falls Utilities	Alliant Energy, GridSecCon 2018, Idaho Power Company, Corn Belt Power Cooperative, MISO