TIP 443: XFACTS Cyber Resilient Flexible AC Transmission Systems

Context

Transmission organizations today face vulnerabilities associated with insider attacks on operation and control systems, including Flexible Alternating Current Transmission Systems (FACTS) with syntactically correct malicious commands and measurements. Opportunities exist to extend FACTS controls into cybersecurity.

Project Description

The project develops a domain-based scheme of FACTS control devices, and high level system controllers such as wide-area measurement, protection, and control (WAMPAC) devices, supervisory control and data acquisition (SCADA)/Energy Management Systems (EMS) servers, and other high level control devices. These are applied and tested in a large utility system to defend against insider attacks that aim to disrupt electric power service and delivery by maliciously changing FACTS set points, spoofing spurious FACTS related control commands and measurements, and altering a device configuration, even in circumstances when commands and data are compliant.

BPA In-Kind Contribution

The defense system will be tested and demonstrated at a BPA facility to validate the timing and security aspects. BPA will also provide modeling and technical support, and support commercialization of developed functions in the following areas:

- Allocation of personnel with suitable skills and experience to complete the tasks and provide the specified deliverables in timely fashion
- Lead and supervise the final demonstration of the project in a BPA lab
- Build a high-fidelity real time digital simulator (RTDS) model of a Static Var Compensator (SVC) station and surrounding power system that will be used for the demonstration
- Review, update and extend the FACTS cyber security threat model document.
- Provide input to the requirements specification of the XFACTS functions

Why It Matters

The outcome of this project will enhance FACTS controllers, SCADA/ EMS servers, and other devices with new firmware to support defense mechanisms against cyber vulnerabilities and insider attacks. The system will alert operators with the identity of any malicious cyber commands and measurements acting on FACTS devices.

Project Goals and Objectives

The goal of this project is to design and test domain-based methods for improved defense-in-depth cybersecurity solutions of utility transmission control systems (FACTS).

The designed defense system expects to achieve a robust capability in performance with component-level validation in a laboratory setting with real time digital simulators.

BPA Goals and Objectives

- The project intends to develop a threat model report that can provide guidance for BPA cyber risk mitigation plans.
- Additionally, the project will provide an RSCAD model for BPA system studies related to FACTS protection and control.
- Finally, the envisioned cyber-physical security test bed can be used for simulating operational impacts of ongoing cyberattacks, their detection and mitigation.

Deliverables

The planned project deliverables include:

- Technology pilot for evaluation and testing
- Demonstration of technology on Static Var Compensators and Series Capacitors
- Threat model document detailing threat scenarios, relevant vulnerabilities, and impact
- Project reports and related publications
- RSCAD model of a BPA substation configuration with built-in controller
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Project Start Date: January 2019  
Project End Date: May 2024

Related Projects
TIP 335: ABB Collaborative Defense of Transmission and Distribution Protection and Control Devices against Cyber Attacks

TIP 397: Cyber Attack Resilient HVDC System – DOE CEDS Initiative

Project members include:

ABB Enterprise Software Inc., a subsidiary of Hitachi Entergy Ltd. (project lead),

Bonneville Power Administration (BPA) (testing lead and project support)

University of Illinois at Urbana Champaign (UIUC),

Iowa State University (ISU),

University of Idaho (UI),

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