



TIP 315: Develop Self-Monitoring Substation Protection and Control System using the IEC 61850 Standard and PMU Data from Protective Relays

Context

Modern Micro-processor relays support Phasor Measurement Units (PMUs) and Generic Object Orientated System-wide Events (GOOSE) messaging of the IEC 61850 standard. If PMUs are enabled, AC measurements can be continuously verified by comparison. Using GOOSE messaging for input and output functions allows utilities to continuously monitor these inputs and outputs.

The IEC 61850 standard and Synchrophasor technology offer a unique solution for self-monitoring solutions that may allow utilities to minimize maintenance procedures and extend maintenance intervals under the NERC PRC-005-03.

Description

The project constructs a substation automation system lab simulator using BPA standard SER/SCADA equipment and BPA standard protective relays. It will show that by applying PMU technology that is integrated in microprocessor relays, can be used to compared from redundant sets to validate their AC signals. The technology also utilizes the monitoring features found in the 61850 standard.

Work included:

- The performance of basic interoperability test's between IED and SER/SCADA RTU;
- Utilization of the protective scheme developed in 2013 that consists of a bus differential/breaker failure relay protection design that replaces the 86 lockout relays by using GOOSE messages over an Ethernet network.
- .Define FIN security requirements and apply them to design of project simulator
- Contracting NovaTech to develop HMI screens and logic to monitor AC Inputs using PMUs and input and outputs using GOOSE messaging.
- Constructing a substation automation system lab simulator using BPA standard SER/SCADA equipment and BPA standard protective relays
- Troubleshoot configurations for Security and Reliability
- Review Results and determine if knowledge gained can be applied to Capital Project in 2016

Benefits

Results from the project demonstrated how to minimize maintenance procedures and extend maintenance intervals for 12 years or beyond with a self-monitoring substation protection system that meets the relay maintenance standard NERC-PRC-005-3.

The project focused on developing monitoring features of the protection circuits which increases the value of the system by detecting problems in real time verses discovering a failure during system event.

Accomplishments

Phase 1 of TIP 315 advanced the TR level of I/O monitoring via IEC 61850 GOOSE messages from 2 to 4. Phase 2 will advance TR level from 4 to 6 by building on the research of the 61850 GOOSE I/O monitor developed in the lab built in the Phase 1. This project demonstrated that the 61850 technologies available in the substation SER/SCADA equipment, and the PMU data available in protective relays can be applied to self-monitor substation automation/protection systems which meets the NERC-PRC-005-3 standard.

Phase 2 of this project continues as TIP 374: Integrate Self-Monitoring Features of Substation Protection and Control System Equipment.

This project builds on the 61850 lab constructed from TIP 315 by further developing the research of binary input/output monitoring using IEC 61850 GOOSE messages and by applying another vendors 61850 Sample Value technology for AC input monitoring.

Phase 2 also focuses on the automatic configuration of the protection monitoring logic and HMI screens directly from the 61860 files of the protection system built in the lab.

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Project Start Date: October 1, 2014

Project End Date: September 30, 2015

Funding

Total Project Cost: \$281,000

Deliverables

Complete design package for the substation automation lab simulator including; All system protection drawings including, one-line, schematics, wiring diagrams, GOOSE message tables; Network design diagram; Relay setting and configuration files; 61850 configuration files; Data System Design prints including alarms schematics and logic diagrams; RTU Configuration File

Substation automation simulator

Report documenting the results of the capabilities of the substation automation system to monitor protective relays and the ways they meet the NERC PRC-005-3 standard

For More Information Contact:

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Participating Organizations

NovaTech

Related Projects:

TIP 335 - Collaborative Defense of Transmission and Distribution Protection and Control Devices against Cyber Attacks (in an IEC61850 environment)

TIP 25b – EPRI Application Guides, Software Tools and Migration Strategies for the Implementation of the IEC 61850 Standard – Level 2

EPRI - Technology Assessment and Demonstration of Emerging Digital Interfaces for Instrument Transformers in Protection and Control Applications

TIP 374 - Integrate Self-Monitoring Features of Substation Protection and Control System Equipment