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Ameren Illinois

3rd Quarter 2016 Smart Grid

Test Bed Report

November 14, 2016

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Executive Summary

Ameren Illinois Company (AIC) submits the following Smart Grid Test Bed Quarterly Report in accordance with the Energy Infrastructure Modernization Act (EIMA), 220 ILCS 5/16-108.5 et seq. This report provides updates on the steps Ameren Illinois has taken to implement its test bed plan during the fourth quarter of 2015. The report includes information on activities Ameren Illinois has undertaken to further develop its “primary” test bed location, discussions with potential test bed customers, and on the testing application process.

Department Of Energy (DOE) Funding Opportunity Projects

Technology Applications Center (TAC) personnel continue their work on the following Department of Energy (DOE) funded projects.

- **(CODEF) - Collaborative Defense of Transmission and Distribution Protection and Control Devices Against Cyber Attacks**

Primary Investigator – ABB

Partners – University of Illinois – Urbana/Champaign (UIUC)

This project will advance the state of the art for cyber defense methods for transmission and distribution grid protection and control devices by developing and demonstrating a distributed security domain layer that enables transmission and protection devices to collaboratively defend against cyber-attacks in an International Electrotechnical Commission (IEC) 61850 environment.

The project team submitted a publication of CODEF conference paper to the Protection Automation & Control World (PACW) America’s conference. The paper was titled “Collaborative Defense in IEC 61850 Substation Environments (CODEF): From Research Lab to Utility Field Demonstration Experience”. The PACW America’s conference was held in Raleigh North Carolina from August 29th through September 1st 2016. Representatives from Ameren Illinois and UIUC delivered a presentation of the paper at the conference.

- **(SDN) – Software-Defined Networking**

Primary Investigator: Schweitzer Engineering Laboratories (SEL)

Partners –UIUC, Pacific Northwest National Laboratory

SDN allows a programmatic change control platform, which allows the entire network to be managed as a single asset, simplifies the understanding of the network, and enables continuous monitoring in more detail. Control system networks are often more static, while the corporate world is more dynamic.

In August 2016, Schweitzer Engineering Laboratories was notified by DOE and the National Energy Technology Laboratory (NETL) that they were being awarded a new grant under Funding Opportunity Announcement No DE-FOA-0001441 titled, "Industry Partnerships for Cybersecurity of Energy Delivery Systems (CEDSS) Research, Development and Demonstration for the Energy Sector". This new project is entitled "The Chess Master Project" is an alliance between Schweitzer Engineering Laboratories, Ameren Corporation, Sempra Energy, and Veracity Security Intelligence. The Chess Master project will utilize the SDN Load Flow Controller and substation hardened SDN switch that was successfully tested at Ameren Illinois' Technology Applications Center in February 2016.

In October 2016, SEL announced that its SDN Load Flow controller, SEL-5056, and SDN Network Switch, SEL-2740S were available for purchase.

- TAC staff attended the kickoff meeting of the **Defense Advanced Research Program Agency (DARPA) project titled Rapid Attack Detection, Isolation and Characterization System (RADICS)** at UIUC on September 9, 2016. This project will establish a cybersecurity test bed at UIUC to enable the testing of cyber solutions that are developed as part of this initiative. Ameren Corporation will support this initiative by providing guidance and insight on a typical utilities infrastructure contains.

Other Current Test Bed Projects

- TAC personnel continued testing of Light Emitting Diode (LED) Street lights that are comparable to 250 watt sodium vapor high-intensity discharge lamps to provide testing results that will assist AIC leadership in making the determination of whether or not to develop a new lighting tariff offering to AIC customers. Testing was completed during 3Q, 2016 and Ameren Illinois is finalizing its report that will be provided to leadership in 4Q, 2016.
- Ameren Illinois continues the testing of Home Area Network (HAN) devices through AIC's Smart Device Validation testing process. This testing process allows AIC to validate that vendor devices operate correctly with Ameren Illinois' Advanced Meter Infrastructure (AMI) system. During the 3Q, 2016, Ameren Illinois did not receive any additional vendor devices as a result of the vendor outreach initiative.
- Electric Power Research Institute (EPRI) Field demonstrations of the ANSI/CEA-2045 Modular Communication Interface Standard - Four field demonstration devices (Controllable Thermostat, Heat Pump Hot Water Heater, Pool Pump, and Electric Vehicle Supply Charger) are presently being developed by research partner vendors, to enable demand response testing of devices utilizing the modular socket communications platform. During the 3Q, 2016, Ameren continued its testing of the universal control module that is being utilized to control the Heat Pump Hot Water Heater device. Ameren Illinois TAC employees are supporting EPRI in identifying and resolving some issues with the EPRI provided universal control modules. Ameren also received a CEA 2045 equipped Pool Pump. Testing the new Electric Vehicle Charging Station and Pool

Pump will begin as soon as Ameren receives the appropriate Universal Control Module (UCM) from EPRI.

- As part of Ameren Corporation's Innovation Team initiative, TAC staff supported the design and installation of equipment for three Innovation team initiatives as follows:
 - **Smart Sensors** – This project is collaboration between Ameren Corporation and the Electric Power Research Institute and is researching the use of pole sensors to provide data about pole movements that may enable assessments of pole health. During this reporting cycle, 21 pole sensors were installed on overhead poles either at the TAC or in close proximity to the TAC site.
 - **Advanced Street Lighting Applications** – This projects goal is to research technologies that could be deployed on Ameren Corporations overhead street lighting system to provide additional services to Ameren customers. Through deployment of communications and sensors, including video nodes, Ameren hopes to learn the capabilities of these technologies as well as the costs and resource requirements that are necessary to install and maintain these systems. Communication systems to three poles, video cameras for two poles and motion sensors for one pole were deployed during this reporting cycle.
 - **Distributed Energy Resource Integration** – Innovation team members including representatives from the TAC, are working to research how Distributed Energy Resources (Solar PV, Wind Turbine, Natural Gas Generators, and an Energy Storage (Battery) can be integrated into the electric distribution system. The project team has awarded an Engineer – Procure – Construct (EPC) contract to deploy these Distributed Energy Resources on the TAC site by the end of 2016.

Test Bed Applications

- Ameren Illinois received an application from a Sensor solutions manufacturer. The manufacturer desires to have its application of smart partial discharge sensors tested inside an Ameren substation power transformer, to validate its functionality in capturing partial discharge waves and its ability to provide trending tools that allow for data analysis. Ameren Illinois and the vendor were able to finalize the testing and verification plans for the vendor product at an Ameren Illinois substation. Ameren Illinois and the vendor were able to successfully finalize cost estimates and contract documents and those were executed by the Ameren Illinois and the vendor on September 6th 2016. Installation of vendor solution started on October 17th 2016.
- Ameren Illinois continues to work with a Sensor and Network devices manufacturer. The manufacturer originally desired to have its application of bi-directional current sensing equipped with a Supervisory Control and Data Acquisition (SCADA) communication package developed and tested at the TAC's infrastructure. Ameren Illinois met with the vendor and learned that the vendor is now looking to develop a low cost transformer monitoring solution that will be

supported with a Supervisory Control and Data Acquisition (SCADA) communication package. Ameren Illinois and the vendor plan to develop the testing scope and verification processes in 4Q, 2016, and then install and implement the solution at the TAC in 1Q, 2017.

- Ameren Illinois received an application from a Power Equipment manufacturer. The manufacturer desires to have its application of soft closing protective devices to be verified and tested on the TAC infrastructure. Ameren Illinois continued discussions with the vendor to develop scope of work involved in testing and developing the product.
- Ameren Illinois received an application from a Power Equipment manufacturer. The manufacturer desires to have its application of distribution automation protective devices be developed and tested at the TAC's infrastructure using the IEC-61850 communication standard. Ameren Illinois continued discussions with the vendor to develop scope of work involved in testing and developing the product.

Industry Participation

Members of the TAC staff attended the Protection Automation & Control World (PACW) America's conference in Raleigh N.C and presented on the DOE CODEF project.

Members of the TAC staff participated in an Innovation Team meeting with Elevate Energy to learn more about the services that Elevate Energy provides.

Members of TAC staff met with several providers of Advanced Street Lighting services to assess whether the vendors technologies were of interest to Ameren Corporation.

Members of TAC staff participated in several EPRI webinars associated with Energy Storage & Distributed Energy Resources.

Test Bed Tours

- On August 1, 2016, TAC staff provided a tour of the TAC facility to representatives from LiteSheet Company.
- On August 16, 2016, TAC staff provided a tour of the TAC facility to Utilidata to discuss a potential TAC application.
- On August 23, 2016, TAC staff provided a tour of the TAC facility to representatives of Atomation Corp.
- On September 19, 2016, TAC staff provided a tour of the TAC facility to representatives of the Transmission, Planning and Operation Coordination Team of Commonwealth Edison Corporation.

Smart Grid Test Bed Plan Success

Ameren Illinois' commitment to the successful implementation of its Smart Grid Test Bed plan is strong. However, as set forth above, Ameren Illinois reserves the right to modify, amend or alter this plan, as necessary and consistent with the law, to meet the requirements and objectives of the EIMA and other related provisions. Additionally, Ameren Illinois reserves its right to terminate this plan.