



2017 ADMS Program Steering Committee Meeting Project Summary

Project Title: Advanced Distribution Management System Testbed Development

Organization: National Renewable Energy Laboratory

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FY 2018 Funding (\$K): 1.8M

Project Objectives and Outcomes

This project will establish a national, vendor-neutral Advanced Distribution Management System (ADMS) testbed to accelerate industry development and adoption of ADMS capabilities for the next decade and beyond. The testbed will enable utility partners, vendors, and researchers to evaluate existing and future ADMS use cases in a test setting that provides a realistic combination of multiple utility management systems and field equipment. The project will work closely with an Industry Steering Group to ensure that electric utility (“utility”) needs are met and use cases are realistic and valuable.

Significance and Impact

The testbed will provide a less-expensive and lower-risk alternative to a pilot deployment, plus the ability to simulate contingency scenarios that are not practical to test using a real distribution system. The findings from ADMS testbed evaluations can improve effectiveness of subsequent trial deployments. The ADMS testbed will allow utilities and vendors alike to evaluate: 1) the impact of ADMS functions on system operations; 2) interoperability among ADMS system components; 3) interactions with hardware devices; 4) integration challenges of ADMS with legacy systems; and 5) ADMS vulnerability and resiliency. The proposed ADMS testbed fills an important gap between new ADMS technologies developed by vendors and the actual pilot deployment of those technologies. To accelerate the state of the art of advanced distribution automation (ADA), this gap needs to be filled by an independent third party such as national laboratories.

Technical Approach

This ADMS testbed is being developed to encompass three major elements: 1) Modeling large-scale distribution systems for evaluating ADMS applications, 2) Integrating distribution system hardware in NREL's Energy System Integration Facility with simulations for power hardware-in-the-loop experimentation and 3) Developing advanced visualization capabilities to analyze the results. NREL is working with utilities and vendors to demonstrate the capabilities of the ADMS testbed through evaluation of advanced DMS applications (such as VVO, FLISR, OPF and market participation of distribution assets) for specific use cases within a realistic environment. The ADMS and other management systems under test will interface with a hybrid hardware/software simulation environment that represents a utility distribution network. The core ADMS testbed consists of a multi-vendor suite of off-the-shelf utility management systems, complete with a distribution control room at the ESIF. These enterprise-class systems will control a simulated distribution system through a combination of real-time software simulation coupled with hardware-in-the-loop simulation. This approach allows users to accurately simulate the distribution system at both steady state and dynamic timescales, and to assess performance and benefits of advanced ADMS functions in a field-like environment. Finally, a system-level visualization will clearly portray the ADMS performance on timescales from sub-second to years, and from a single device to the entire utility region. This capability will greatly help in assessing the benefits of the use cases under test.

Technical Progress and Results (1/2 of page)

The team established an industry advisory board (IAB) and is having quarterly IAB meetings. The team also developed a test plan for use case 1 and executed use case 0. The capability development for use case 1 is under way. Progress for each use case is presented below.

- Use case 0 – ADMS integration with PV inverters for Volt-VAR control
 - Identified feeder reduction technique crucial for stability of PHIL co-simulation
 - Created voltage regulator for stable operation of PHIL with PV inverter and quasi steady-state simulations
 - Combined the feeder reduction and voltage regulator method and ran multiple experiments on Duke feeder with AE500 PV inverter under Volt-VAR, unity power factor, and 0.95 power factor controls.

- Use case 1 – data remediation for ADMS deployment
 - Identified data remediation for VVO using Xcel Energy feeders.
 - Developed test metrics, test procedure, and expected test outcomes.
 - Procured Schneider ADMS, Beckwith and SEL controllers for voltage control devices, OpalRT's ephasorSIM real-time simulator platform with communication capability
 - Developed specification for a data bus (D-bus) architecture for enabling data exchange between multiple simulation platforms.
 - Developed and released an open source tool to convert distribution system models from OpenDSS to ephasorSI

Project Summary (continued)

Project Collaborations and Technology Transfer

Xcel Energy is funding NREL to use the ADMS Testbed to evaluate the need for model improvement for its ADMS deployment. Xcel Energy is pursuing grid modernization across its operational territory, starting with the feeders in Colorado. The insights gained from the NREL project is expected to inform and reduce costs for Xcel Energy's approach to ADMS deployment in Colorado and beyond.

The ADMS Testbed team is actively pursuing collaboration with Austin Energy to identify use case 2 for Year 3. This Use case will be targeted at improving the testbed capabilities to evaluate ADMS applications that integrate other utility management systems (DERMS)

The ADMS Testbed has paved the way for further collaborations with industry and DOE. Two new projects under EERE ENERGISE and GMLC Distribution Resilience programs are already identified to utilize the testbed beyond this effort. These projects are establishing new collaborations with Varentec, Duke Energy, GE Grid Solutions, EPRI and others.