2017 ADMS Program
Steering Committee Meeting
Project Summary

Project Title:	**Multi-Scale Integration of Control Systems (EMS/DMS/BMS)**
Organization:	Grid Modernization Lab Consortium (GMLC)
Presenter:	Liang Min, LLNL
FY 2018 Funding ($K):	$1150K

Project Objectives and Outcomes

The goal of this project is to create an **integrated grid management framework** that will be akin to having an autopilot system for the grid's interconnected components — from central and distributed energy resources at bulk power systems and distribution systems, to local control systems for energy networks, including building management systems. By end of this three-year project, the GMLC team will successfully:

- Develop an open framework to coordinate Energy Management System (EMS), Distribution Management System (DMS), and Building Management System (BMS) operations.
- Demonstrate the new framework on a use case at GMLC national lab facilities.
- Deploy and demonstrate new operations applications — probabilistic risk-based operations, forecasting data integration and decision support— that transform or extend existing EMS and DMS applications.

Significance and Impact

This project will support DOE's initiative to accomplish the following three Major Technical Achievements that will yield significant economic benefits for the nation:

- **Reduce the economic costs of power outages.** EMS/DMS/BMS coordination will help improve grid stability. It will also help grid operators leverage distributed energy resources (such as smart inverters and demand response) and avoid conditions that could lead to load shedding or cause outages.

- **Decrease the cost of reserve margins while maintaining reliability.** Real-time controls through robust data analytics and integrated forecasting information will enable grid operators to reduce generation tripping on special protection schemes, to optimally schedule generation to meet demand, and to substantially reduce the amount of system reserve capacity needed to cope with generation and load fluctuations, while maintaining and even increasing system reliability.

- **Decrease the net integration costs of distributed energy resources.** EMS/DMS/BMS coordination will help DMS better engage with bulk system reliability management and coordinate across local intelligent assets, including multiple microgrids, over a range of feeder innovations that meet changing consumer expectations and traditional demand for reliability, resilience, and affordability. EMS/DMS/BMS coordination with controllability to engage response loads will help balance the variability of DERs.

The proposed project will also help improve utility system efficiency through reduced electric losses. ESM/DMS/BMS coordination will help manage peak feeder loads, locate electricity production closer to the load, and ensure that customer voltages remain within service tolerances, while minimizing the amount of reactive power provided

Technical Approach

The current grid operating systems were developed over the last three to four decades using a piecemeal approach, within narrow functional silos. The rapid growth of DERs and the increased need to integrate customers with the power system are rendering the current generation of grid operating systems obsolete.

This project is to develop an open framework to exchange information between the electric grid's EMS, DMS, and BMS control systems. To create this framework, the project team will build interfaces to EMS, DMS, and BMS that are suited for the hierarchical structure of organizations' utilities, as shown in Figure 1. The interfaces will align with core area 1.2.1 (grid architecture development) and follow the guidelines developed in that area. The diverse and large number of buildings connected to the distribution system requires a framework that enables scalable messaging, which will be installed at several locations and

registered with each location. In addition, the integration requires the project team to build profiles for the information models and data exchange. The expectation is that the project will use interoperability standards that are developed from core area 1.2.2 (interoperability) and common information models (where available) to ensure a common interpretation of the data exchanged across the interface.

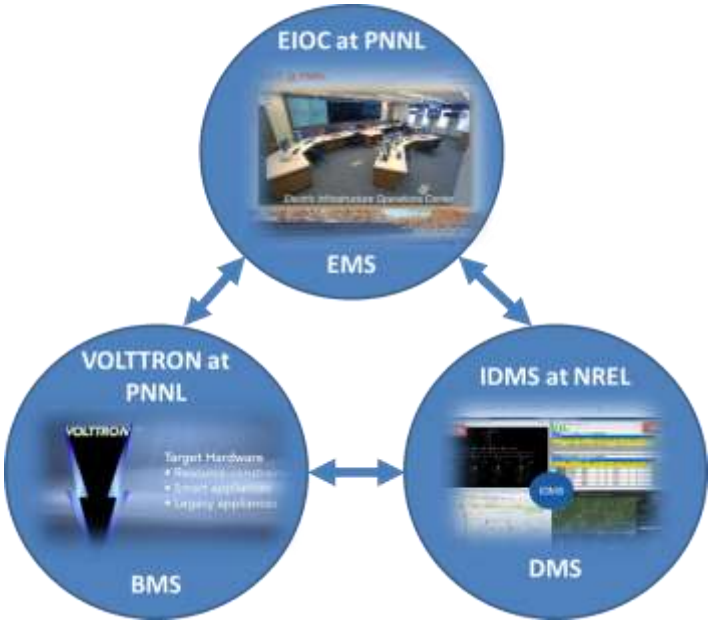

Figure 1. Collaborative effort to develop a Multi-Scale Integration of Control System

Technical Progress and Results

Milestone (FY16-FY18)	Status	Due Date
FY16 Mid-year Milestones: Completed the use case report and data exchange requirements/protocols report.	Done	12/1/2016
FY16 Annual Milestones: Complete integration of LANL ED with SNL UC engine; Complete integration of renewable forecasting into UC and ED.	Done	3/30/2017
F**Y17 Annual Milestones:** Demonstrate integration of DMS and BMS information on the use case proposed under task 1; Complete the formulation of new DMS/BMS applications for EMS operations and implementation into UC/ED;	40%	3/30/2018
FY18 Annual Milestones: Successfully demonstrate integrated EMS/DMS/BMS platform; Demonstrate new DMS/BMS applications in UC/ED EMS; Demonstrate the uncertainty modeling and forecasting method in the integrated EMS/DMS/BMS system.	Not started	3/30/2019

Project Collaborations and Technology Transfer

PJM Interconnection: PJM Interconnection operates the world's largest wholesale electricity market as the regional transmission organization. They will support the GMLC team with the transmission of EMS data to help achieve the project demonstration goal of 15,000 transmission substations.

Duke Energy: Duke Energy is the largest electric power holding company in the United States. NREL has collaborated with Duke Energy to implement comprehensive modeling, analysis, visualization, and hardware implementation representative of Duke Energy's utility feeder at the NREL Energy Systems Integration Facility (ESIF). Duke will support this GMLC team by providing distribution feeder data.

General Electric: From 2010 to 2015, GE (former Alstom Grid) contributed to nation's largest smart grid demonstration, the Pacific Northwest Smart Grid demonstration project. GE (former Alstom Grid)'s demo EMS and DMS have been deployed at PNNL's EIOC and NREL's IDMS through previous collaborations. Alstom will be involved in year 1 and 2 to support this GMLC team by making their demo EMS and DMS available for this project.