GMLC Project Communications Summary

Date:
Project Title: Survey of Standards for DER Interconnection and Interoperability
Project Number: GMLC 1.4.1
Principal Investigator: David Narang
Person Completing this Document: Janie Page, LBNL, David Narang, NREL

1. What problem is the project solving or what opportunity is it addressing?
   - *To achieve widespread deployment of emerging DER technologies (e.g. distributed generation, battery storage, responsive loads, electric vehicles) to provide critical grid services, there must be unambiguous communication and coordination between these new technologies. Standards for interconnection and interoperability must be consistent across all devices of a single technology as well as across different technologies that interact related to grid operations to enable the critical benefits for grid reliability, safety, and security both during normal operations and during unexpected events. This project aimed to identify and fill gaps in existing standards related to the interconnection and interoperability of distributed energy resources.*

2. Who collaborated on this project? (e.g. labs, universities, utilities, vendors, others)
   - *Argonne National Laboratory*
     - *Theodore P. Bohn*
   - *Idaho National Laboratory*
     - *S. M. Shafiul Alam, Manish Mohanpurka*
   - *Lawrence Berkeley National Laboratory*
     - *Richard Brown, Janie Page, Mary Ann Piette, (Project Co-Lead) Peter M. Schwartz*
   - *National Renewable Energy Laboratory*
     - *David Narang (Project Lead), Barry Mather, Andy Hoke, Samanvitha Murthy*
   - *Pacific Northwest National Laboratory*
     - *Steve Widergren*

- *Oak Ridge National Laboratory*
    - *Yaosuo (Sonny) Xue*
- *Sandia National Laboratories*
    - *Sigifredo Gonzalez*

3. What is the solution or outcome that the project delivered?

    a. *The team identified and evaluated key standards across multiple domains to identify gaps (defined as any activity needed to harmonize requirements among standards development organizations, minimize conflicting requirements among technology domains, or streamline conformance test procedures) preventing effective management of DER grid services.*
    b. *The team identified challenges posed by interconnection, interoperability, and testing of DERs.*
    c. *The project team worked to fill identified gaps by working with standards development efforts and validating needed interconnection and interoperability standards and test procedures for DERs at national laboratory facilities*
    d. *Project team members provided direct input to standards development efforts under various working group efforts across multiple standards development organizations to foster harmonization of requirements across DER technology domains.*

4. How does the solution/outcome break new ground or how is it differentiated from other R&D projects?

    1) The standards gap analysis conducted during this project examined what work is needed to provide unambiguous, reliable connections from a wide range of distributed energy resources to support grid needs and categorized these in terms of what can be done now (or near term) vs. those requiring more work or not yet sufficiently developed to provide grid services.

        a) <u>near term</u> efforts are expected to be productive with

            i) inverter-based systems for energy, frequency regulation, ramping, and voltage management, and

ii) *grid connected microgrids*

b) *additional work is needed to allow responsive loads aiming provide needed grid services to reached its full potential*

c) *the nascent stage of commercialization of EVs and EV supply equipment suggests that these technologies could have high potential in the future but are not sufficiently developed or deployed to be useful at this time.*

5. How is the deliverable or outcome of the project being used?
   - *The analyses developed in this work include recommendations that could be used to inform standards development organizations and working groups to consolidate or harmonize interconnection and interoperability requirements for DER technologies across the relevant standards.*

6. Impact metrics – has project impacted grid modernization in any quantifiable way? (E.g. reliability, resiliency, efficiency, DER integration, event response, etc.)

   The project team provided direct input to standards development efforts. The updated standards will result in 1) enhanced ability of distributed generation and storage to participate in grid energy and power interactions; 2) improved coordination of EVs through harmonization of communications standards with interconnection and interoperability requirements; and 3) advancement of standards to accelerate participation of responsive loads in energy transactions.

7. What IP and/or industry recognition or adoption has the project resulted in?

   - *Team members contributed to changes in the following standards:*
     - *IEEE 2030.5, 2030.7, 2030.8, 1547, 1547.1, and combined PSCCC and PSRCC*
     - *ASHRAE 201 (FSGIM) and ASHRAE 135 (BACNet)*
     - *OpenADR2.0*
     - *SunSpec and Modbus*

- *IEC 61850, ISO/IEC 14908 Part 1(LonMark and LonTalk)*
- *UL 3001*
- *NERC DER TF*
- *SAE J3072, J2836/0/3, J2847/2/3, J2894/1/2, J2953 PEV-EVSE, and associate mapping to IEEE 2030.5*

- Journal and Publication Articles
- Conference Presentations
- *National webinar on ESI concept presented by LBNL on May 14, 2018.*
- *GMLC Survey of Distributed Energy Resource Interconnection and Interoperability Standards*

8. If you look ahead 5-10 years, how do you see the work of this project impacting grid planning and operations in the U.S.?
    - *The project team contributed to updates to some of the most widely adopted standards across the United States for existing DER. These updated and revised standards will help to improve the interoperability of DER such as inverter based DER including PV and energy storage and will also pave the way for increased reliance on these technologies under both normal and abnormal grid conditions. Looking ahead to the provision of grid services from newly emerging DER technologies such as electric vehicles, and responsive loads, this project has contributed to efforts in these industries to develop widely applicable interfaces such as the energy services interface. Industry efforts are ongoing and could benefit from the reference material and recommendations in the team's survey and gap analysis report (GMLC Survey of Distributed Energy Resource Interconnection and Interoperability Standards).*