GRID MODERNIZATION LABORATORY CONSORTIUM
U.S. Department of Energy

GMLC Project Communications Summary

Date: 11/15/2019
Project Title: Definitions, Standards and Test Procedures for Grid Services from Devices
Project Number: GMLC 1.4.2
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1. What problem is the project solving or what opportunity is it addressing?
    - The project addresses the development of *a general, standard battery-equivalent interface applicable to device models representing a range of device classes.* These device models will be in the form of an equivalent battery model, useful for comparing and aggregating the capabilities of devices from different classes and extrapolating their ability to perform grid services. This device-specific models are designed to be modular and readily incorporated in grid planning and operational tools for engaging DERs to provide large-scale grid services.
2. Who collaborated on this project? (e.g. labs, universities, utilities, vendors, others)
    - National Laboratories- Pacific Northwest National Laboratory, Oak Ridge National Laboratory, National Renewable Energy Laboratory, Argonne National Laboratory, Sandia National Laboratory, Idaho National Laboratory, Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory

3. What is the solution or outcome that the project delivered?
    - Enable utilities and grid-operating entities to accurately assess the contribution of DER devices at the planning and operational time scales by using models of their performance that can be incorporated into the tools used to plan and operate the grid.
    - Encourage device manufacturers to add the capabilities needed to supply existing and new grid services by clearly articulating the performance characteristics

required and a means for evaluating their devices engineering and economic potential in various regions of the nation.

- Manufacturers and utilities have access to defined grid service drive cycles and software for performing trial analysis of fleet of DERs to provide grid services

4. How does the solution/outcome break new ground or how is it differentiated from other R&D projects?
    - The project demonstrated for the first time 1) framework and metrics for constructing battery equivalent models of different DERs, 2) battery-equivalent models for variety of DERs, 3) evaluation of device fleet's ability to provide grid services using models.

5. How is the deliverable or outcome of the project being used?
    - By industry?
    - By government?
    - Other?
        i. The project developed models and integration software for evaluating DERs' ability to provide grid services. The outcome is useful for utilities and manufacturers (not currently being used but outreach efforts are underway by various teams towards this goal).
6. Impact metrics – has project impacted grid modernization in any quantifiable way? (E.g. reliability, resiliency, efficiency, DER integration, event response, etc.)
    - The project addressed flexibility that DER devices offer that will make a large contribution to two of the achievements: (1) *a grid operating reliably on a lean reserve margin* and (2) *a resilient distribution system supporting high penetrations of renewables and other low-carbon DERS (50%)*. The project produced device models that are a critical component of the third achievement: (3) *an advanced modern grid planning and analytics platform* using uniform modeling of DERs. The project developed a standard set of definitions for grid services, and developed a technology-neutral consensus-based standard for variety of DERs to provide grid services.

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

- Patents
- Licensing
- Open Source Adoption
- Journal and Publication Articles
- Conference Presentations

    i. GMLC Report – "Battery-Equivalent Models for Distributed Energy Resource Devices' Ability to Provide Grid Services"
    ii. GMLC Report – "Grid Services from DER Device Fleets: Volume 2 – Trial Analysis"
    iii. GMLC Report – "Testing of Distributed Energy Resource Device Models - Electric Vehicles, Electric Water Heaters, and Commercial Refrigeration Systems"
    iv. 1st Industry Workshop Presentation – "GMLC 1.4.2 – Definitions, Standards and Test Procedures for Grid Services from Device Fleets", Golden, CO, September 13th 2016
    v. 1st Industry Workshop Presentation – "Introduction to DOE's Grid Modernization Device Characterization Initiative" March 22nd 2017

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.?
    - Items of the *Future Projects* discussion allude to several ways that the battery-equivalent representation could be an important concept for improving grid planning and operational processes. Whether that potential to unify and simplify the representation of the flexibility offered by devices takes place or not depends on the degree to which the advantages of such an approach are recognized and adopted. This will take some time. The potential of the approach could be utilized in a broad set of ways as discussed above. Collectively, they would have a profound impact. Individually, they may prove specifically valuable to a variety of aspects of future grid planning and operations. Hopefully the potential advantages shown by the project will

become clear, gradually recognized, and incorporated in such tools. On-going publicity, coordination, and investment by DOE would help these advantages be realized sooner rather than later.