Definitions, Standards and Test Procedures for Grid Services from Devices

**Project Description**

Develop characterization test protocol and model-based performance metrics as a *Recommended Practice* for devices’ (DERs’) ability to provide a broad range of grid services, i.e., to provide the flexibility required to operate a clean, reliable power grid at reasonable cost.

### Devices (DERs)

- **Responsive, flexible loads**
  - Water heaters
  - Refrigerators
  - Air conditioners
  - Commercial rooftop units
  - Commercial refrigeration
  - Commercial lighting
  - Electric vehicles (charging only)
  - Electrolyzers

- **Storage**
  - Battery / inverters
  - Thermal energy storage
  - Electric vehicles (charging & discharging)

- **Distributed generation**
  - PV solar / inverters
  - Fuel cells

### Grid Services

- Peak load management (capacity)
- Energy market price response (wholesale energy cost)
- Capacity market dispatch (market value)
- Frequency regulation (market value)
- Spinning reserve (market value)
- Ramping (new)
- Artificial inertia (new)
- Distribution voltage management (new)

### Objectives/Deliverables

- **Recommended Practice** for devices’ (DERs’) ability to provide a broad range of grid services, i.e., to provide the flexibility required to operate a clean, reliable power grid at reasonable cost.
- Developed definitions & drive cycles for grid services (draft for industry review)
- Developed generic device model (battery equivalent+) & extrapolation framework
- Published framework (Recommend Practice Chs. 1 & 2) for industry review (3/17)
- Recommended Practice (Draft for Industry Review) for Grid Services: Equipment Impacts/Outcomes

### Significant Milestones (FY16-FY18)

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Status</th>
<th>Due Date</th>
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<tbody>
<tr>
<td>1. Standard definitions &amp; drive cycles for grid services (draft for industry review)</td>
<td>Complete</td>
<td>October 1, 2016</td>
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<tr>
<td>2. General device model (draft for industry review)</td>
<td>Complete</td>
<td>April 1, 2017</td>
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<tr>
<td>3. Extrapolation procedure for performance of grid services</td>
<td>Complete</td>
<td>October 1, 2017</td>
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<td>4. Draft Recommended Practice (vetted with industry)</td>
<td>Underway</td>
<td>April 1, 2019</td>
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<td>5. Trials of device characterization protocols (each device class)</td>
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<td>April 1, 2018</td>
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<td>6. Manufacturers review characterization protocol &amp; test results</td>
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<td>October 1, 2018</td>
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<td>7. Proof-of-concept testing validates extrapolation procedure</td>
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<td>April 1, 2019</td>
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<td>8. Stakeholder group consensus that Recommended Practice is useful &amp; accurate</td>
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<td>April 1, 2019</td>
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**Progress to Date**

- Developed definitions & drive cycles for broad range of grid services
- Developed generic device model (battery equivalent+) & extrapolation framework
- Published framework (Recommend Practice Chs. 1 & 2) for industry review (3/17)
- Organized series of webinars & briefings leading up to 2nd Industry Workshop:
  - GridWise Alliance webinar (n = 35*)
  - PV/batteries/inverters (n= 321*)
  - Thermal energy storage briefings (n = 2*)
  - Commercial lighting (n = 27*)
  - Electric vehicle meeting briefing (n = 13*)
  - HVAC & appliances (n=21*)
- Partnered with the GridWise Alliance to host 2nd Industry workshop with sponsors GE & Intel @ GE’s GridIQ Center in Atlanta GA March 21-22, 2017 (n = 36*)

* Counts exclude DOE and national laboratory participants