Work group

Power Grid Electrical Energy Storage

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Japan Smart Community Alliance
Today’s Speech

1. Scope of this Work Group
2. Work Group members
3. Work group activities
4. Next Step
Background of this Work Group

- Renewable energy
- Batteries
- Controllable energy demand and supply
- Variable
Grids with incontrollable need ramping ability. California mandate for 1.325 GW new energy storage.
1. Scope of this Work Group

Energy Storage handled in the WG

- Electric Energy Storage System
  - Business opportunities for battery storage systems in various markets (Not technological specifications)

Source) Sumitomo Electric Industries, Ltd.

Source) NGK Insulators, Ltd.
1. Scope of this Work Group

The WG plans to conduct a study on the following:

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| 1 | Collection of possible grid-related issues associated with external environmental change  
  (Issues caused by introduction of large amounts of renewables, etc.) |
| 2 | Collection and analysis of cases using battery systems as energy storage to address issues  
  (Best practice case studies) |
| 3 | Recommendation on the role of battery systems toward resolution of grid-related issues |
2. Work Group members

Australia  Japan
Denmark  South Korea
Flanders  Norway
France  the United States
Ireland

* The Netherlands is planning to join.
3. Work group activities

Energy Storage Functions

System wide services
- Generation
- Transmission
- Distribution

1. Voltage Control
- Consumer
- Prosumer

2. Frequency Control

3. Renewable Integration

4. Microgrid

5. Load Leveling

Supply vs. Demand

Load (kW)

Time
Some Case Studies

1 Voltage Control

Voltage Control

Distance from a distribution substation transformer

101V ± 6V

With PV, full generation

Without PV

Distribution substation

Consumer

Prosumer

PV

PV

PV

With PV

Without PV

101V ± 6V
Some Case Studies

2 Frequency Control

Load > Generation (Regulate Up – Discharge)

Load < Generation (Regulate Down - Charge)

32MW/8MWh GSS™
Laurel Mountain, WV
Performing Frequency Regulation
32 MW Power Capability
8 MWh Energy Storage Capacity
Operational since 2011

20MW/5MWh GSS™

Frequency Regulation
20 MW Power Capability
5 MWh Energy Capacity
Ten Containers with Integrated Inverters
External Chillers and Transformers
Operational September 2013
Some Case Studies

Renewable Integration

Smart Grid Demonstration in Los Alamos, New Mexico

- Compensated fluctuation caused by renewable generation using battery.
- Demonstrated possibility to decrease amount of battery combing with Demand Response.
Some Case Studies

3

Renewable Integration

Some functions for integration.

- Central control for load following
- Central control for VAR compensation
- Local feed-back control for frequency regulation
- Local feed-back control for voltage stability

Fast and accurate control without communication network

Example of multi-objective mode: one device for several scope

Typical 1MW/0.5MWh system
Some Case Studies

4 Microgrid - Miyako Island Mega-Solar demonstration project-

Demonstrative Project of Renewables on Off-Islands with Small Independent Grid in 2009 from METI


5 Load Leveling

Substation

Battery (4MW, 25MWh)

4. Feedback from Work group members

Overview

Questionnaire for WG member.
The status of energy storage introduction and future outlook.

| Respondents | Australia (2), France (2), Ireland, Japan (3), Norway, Taiwan |

New needs for energy storage?

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*Reasons given for no new need of new energy storage:
  • Energy storage facilities already exist in sufficient numbers.
  • New technologies are in the demonstration phase, so it’s hard to tell
4. Feedback from Work group members

• Applications for Battery Energy Storage

Expectations on load leveling/peak cutting, integration of renewable energy, frequency control are high.
4. Feedback from Work group members

Policies for Dissemination of Battery Storage

Many possible policies to help introducing batteries were given:

- Define a function in the transmission and distribution network.
- Allow DSO to independently introduce measures.
- Discussion is needed. Who should be able to own and operate batteries (TSO, DSO, others) ?
- The Electricity Market Reform under way in Japan might work in favor of batteries.
- Financial incentives such as FIT might boost demand for batteries.
4. Feedback from Work group members

Business opportunities for grid battery storage

There are many possible business models for battery storage. Business models listed below are suggested by respondents.

**Currently possible business models**
- Primary reserve (for frequency control)
  *business model being tested in Concept Grid by EDF*
- Load leveling/peak cut

**Future potential businesses**
- Microgrid: Once operation issues & roles are clearly identified
- Ancillary Services for frequency control
- Load leveling, load shifting, frequency stability with high levels of RE penetration
5. Next Step

- Issues to discuss

(1) Define best practice in case studies.
   • Use case
   • Policy support

(2) Recommendation on the role of battery systems toward resolution of grid-related issues