The Results obtained from New Mexico Demonstration

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Traditional Power System (From Generation to Demand)

Generation

Transmission

Distribution

Smart Meter

SCADA
EMS

Control center of utility or energy service provider
The sources of the idea of the New Mexico project

- Danish system operator recommended needs of introduction of micro-grid like operation in micro-grid symposium of 2006, because its power system is depending on power supply from so many distributed generators, such as wind turbines and co-generations.(10kV micro grid)
- Small corporative utility introduced battery storage in North Carolina in 1970’s.
- When visiting the high-quality house which a manager of Japanese-trading company borrowed, its garden was lighted up overnight. We understood that the American high income people are afraid of a blackout very much.
- German utilities mentioned that transfer circuit breaker will be mainstream comparison with islanding detection. So, NEDO testified both technologies through the demonstration.
- There was a boom of the power quality service (premium park) in the United States around 2000.
- A technique of the independent operation from grid system was adapted for the semiconductor factory in Japan. Additionally, this technique has also been adapted in the building for required continuous business plan such as Roppongi Hills.
Grid system with several EMSs

- Smart Grid
- Smart Community
- Smart Users
  - FEMS (EMS for Factory)
  - BEMS (EMS for Building)
  - HEMS (EMS for Residential)

- Focused part of New Mexico Demonstration

- CEMS (Management system located in an area)
- SCADA EMS (Control center of utility or energy service provider)
2 sites of New Mexico Demonstration

- Rio Arriba
- New Mexico University

- PNM
- Mesa Del Sol

- Los Alamos National Laboratory

- Sandia National Laboratories

- University of New Mexico

- Energy Innovation Hub (EIH)
Micro-grid demonstration on a feeder in Los Alamos
System in Smart House
Transfer circuit breaker by PLC (Residential Micro-grid)

<table>
<thead>
<tr>
<th>Communication</th>
<th>Response Time (mean value) [msec]</th>
<th>Error Rate (mean value) [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-Speed PLC (MHz)</td>
<td>5.6</td>
<td>0.589</td>
</tr>
<tr>
<td>Low-Speed PLC (kHz)</td>
<td>239.2</td>
<td>0.146</td>
</tr>
<tr>
<td>Wireless (915MHz)</td>
<td>9.4</td>
<td>0.080</td>
</tr>
</tbody>
</table>

Information resource is master control unit installed on the grid side. This unit creates and send signal such as “Open circuit” or “close”. Signal sent from master control unit will be sent to slave unit in customer side, via micro-DX installed on pole near by customer. Slave unit will operate circuit switch at the customer and send signal to inform finishing of this sequence to utility side, after receiving transfer circuit breaking signal.

Distributed power sources are immediately disconnected when an accident occurs.
Example of Auto Demand Response by communication between HEMS and utility’s EMS

HEMS controls electric consumption by receiving price signal from Micro-EMS.

Source

When price becomes high, stored energy on the battery will be discharged.

Demand Response

- DR Mode
- Reduction %
- PV Generation kWh
- Battery Charge/Discharge, SoC kWh
- Power Consumption kWh
- Energy Flow (Buying or Selling) kWh

Source: KYOCERA
An Example of independent operation of Smart House

Air conditioning demand was controlled with fluctuation of Loaf Top PV generation.
Facilities in Aperture Center building

- 500kW PV
- 2MWh Batteries
- Substation
- Feeder
- Smart meter
- μEMS+MDMS
- Estimated load of building 400kW
- Thermal storage tank
- Air-cooled refrigerator 70USRT
- Air-cooled refrigerator 20USRT
- Cooling tower
- Power controller
- BEMS
- Heat controller
- PV Inverter 50kW
- PV 50kW
- Dummy load 100kW
- Lead storage battery 50/90kW, 160kWh
- Fuel cell 80kW
- Gas engine generator 240kW

Legend:
- Red: Constructed power line
- Blue: Communication line
- Gray: Existing power line
Aperture Center Building Independent Operation

- PCC
- BAT
- PV
- GE
- FC
- LOAD

Grid-connecting → Islanding
Islanding → Grid-connecting

Power [kW]

13:00 13:15 13:30 13:45 14:00 14:15 14:30 14:45 15:00 15:15 15:30
Japan-US collaborative demonstration

US side Facilities

Japan side Facilities
Impact of New Mexico Demonstration in US

NEDO New Mexico Project

NEDO’s Past Micro Grid related demonstration

Referring of Use Case and Case Study

Standardization of Micro Grid Controller at IEEE P2030.7

Starting Information Exchange

Collaboration through workshops

Stanford Univ. Bitts and Wats Project

EPRI Integrated Grid
Committee activity for standardization of Micro Grid controller named MEMS (Micro Grid Energy Management System: Micro-EMS in New Mexico Demonstration). There are concepts as creating Micro Grid Cluster in Washington DC or Manhattan. As the first step effort, they started to establish standards regarding to Micro Grid Controller.

Professor Arun Majumdar in Stanford University, appointed the first director of ARPA-E, is proposing this project. Especially by linking between research about regulation or legislation side and technology issues regarding to IOT, fusion research project between physical science and liberal arts.
Standardization Micro Grid in IEEE

In IEEE P2030, standardization of Micro Grid related technologies. In US, as resilient grid system, cluster of micro grid application adopted in such area as Manhattan or DC becomes an unique idea.
Thank you very much for your attention