Micro-Grid Projects in Japan

and

Gaps and Issues for Micro-grids

Distributed Renewables, Generation, and Storage Domain Expert Working Group

Smart Grid Interoperability Panel

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New Energy and Industrial Technology Development Organization

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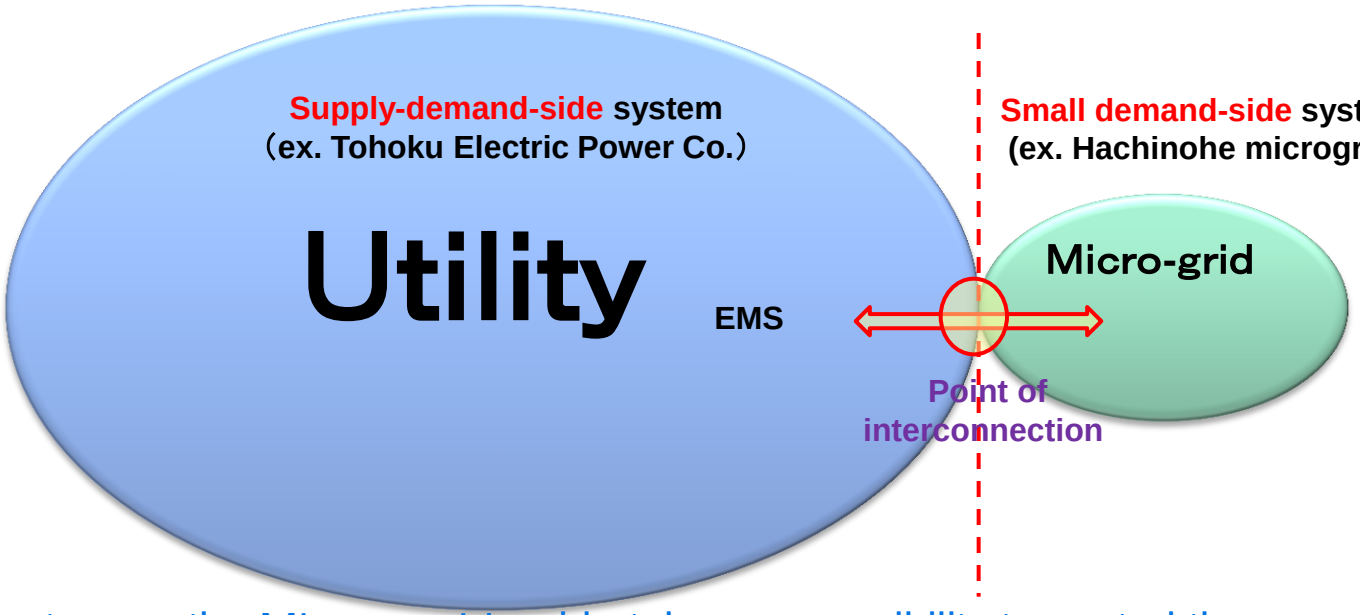
Micro-grid Definition

The technology of a small network which takes "**responsibility**" for balancing demand and supply, absorbing output fluctuations of loads and renewable energy, and maintaining electricity **by itself**.

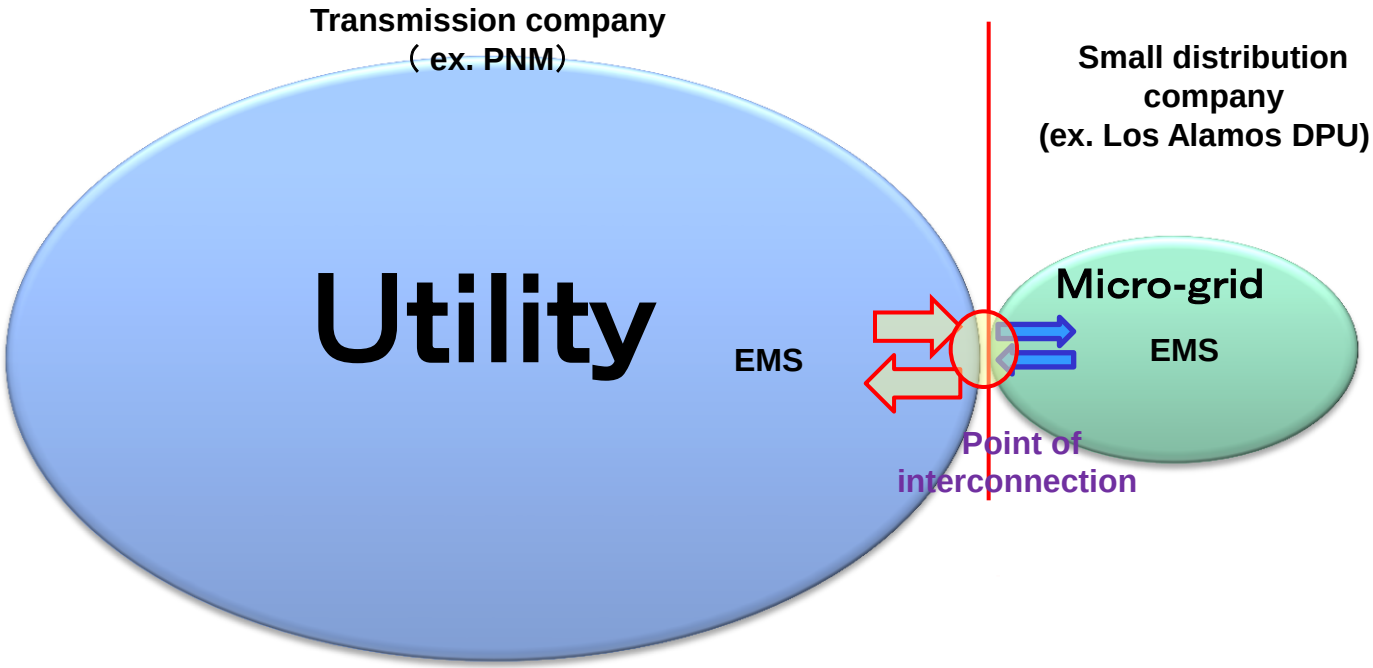


- The system on the Micro－grid－side takes responsibility to control the power flow at the point of interconnection to address the balance of demand and supply and frequency control on the utility side.

- Vertically-integrated (It is easier for vertically-integrated companies which control generation, transmission, distribution and facility to introduce and control Micro-grids.)<<Japan
- Implementation of retail liberalization (in cases of separation of distribution facilities and sales) makes it difficult to compose Micro-grid.<<U.S. & Europe

Gaps and issues for Micro-grids

Utility side (transmission companies) and Micro-grid side (distribution companies) **both need to adjust the scope of "responsibility"**, where the generation company and transmission company are unbundled. To achieve shared "responsibility", standardization is essential, for example for information sharing.



➢ Will applying EMS to distribution companies will facilitate the development of Micro-grids?

Gaps and issues for Micro-grids

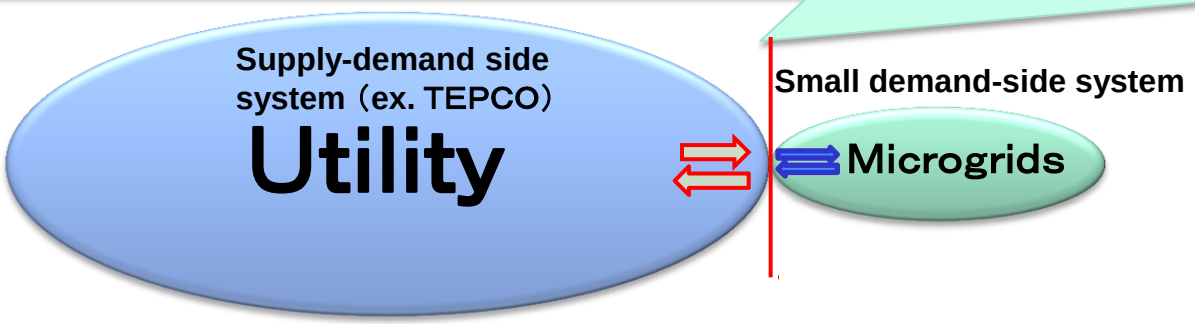
What information is needed for the demand-side to control power-flow with "responsibility" according to the power balance of the utility-side?

◆What time span is adequate to adjust target flow between grids
30min? 15min? ・・・?

◆Communications between upstream and downstream EMS, protocols (communication intervals, monitored data (such as active power, reactive power, voltage, etc.), forecasted values), security (encryption), etc.

◆What data from utilities and standards are needed for bilateral adjustment ?
(Balancing supply and demand, independent operation, voltage & frequency control)

◆In a fully deregulated market, a virtual micro-grid will be created due to the exit of several energy providers.



NEDO Contribution to DRGS DEWG

1.Understanding of the Differences between the Power Industry in U.S. and Japan

2.Use Cases

3.Knowlege of demonstration projects using Japanese technologies and systems

【Past Project examples 】
（1）Management of distributed power sources

- **Voltage management and control or protection by central control using an optical network where clustered PV systems are connected.**

- **Technology to isolate rapidly clustered PV systems when outages happen.**

(2) Micro-grid

(a) Power-flow control at the point of interconnection

- Controlling error between planned flow and actual flow within 3%, moving over a time horizon of every 6 minutes
- Load following control by considering response speed and economic balance between battery and gas-engines

(b) Independent operation/self-generating self-consuming

- One Week independent operation. Analysing frequency, voltage, negative-sequence current, harmonics voltage distorted rate.
- Local control to follow load changes at10 msec intervals. PV inverter which has the capability to compensate negative-sequence current for independent operation.

(c) Using public communication networks for controlling Micro-grids every 5 min. Balancing demand and supply

(d) Development of AC virtual Micro-grid simulation method.

NEDO Contribution to DRGS DEWG

【Future Project examples】

(3) Demand response・HEMS (NM Los Alamos)

・Analysis of battery characteristics to control PV output fluctuation with storage battery

・Analysis of demand response function of residential PV/ storage battery/ HEMS, by sending signals of real-time charge with EMS of distribution system and system monitor

・Reflection and management of charge signals and weather information to PV, storage battery, heat storage device, and home electronics

(4) Urban Micro-grid・BEMS (NM Albuquerque)

・Installation of Micro EMS and interconnection with BEMS and communication system

・Construction of Zero Energy sustainable commercial building

・Absorption of renewable energy fluctuations by a system comprising a fuel cell, gas engine cogeneration, heat storage tank, and storage battery

NEDO Contribution to DRGS DEWG

(5) Advanced Smart Grid Concept based on Community Energy Management System (CEMS), including BEMS, HEMS, EV technology (V2G, V2H, Quick chargers):

(a) Advanced electricity systems using high-performance secondary batteries such as Lithium ion.

(b) EMS combining legacy electricity systems with information and communication technology (ICT).

- R&D of advanced electricity systems and applications for energy management
- Verification tests on the validity of energy management systems integrated in CEMS

Four Different Operating Modes Demonstrated in NEDO Projects

- Avoiding voltage increases on distribution lines
  - **Demonstration Project on Grid-interconnection of Clustered Photovoltaic Power Generation Systems**
- Reducing output fluctuations from renewable energy
  - **Wind Power Stabilization Technology Development Project**
- Achieving scheduled output from renewable energy
  - **Verification of Grid Stabilization with Large-scale PV Power Generation Systems**
- Balancing demand and supply on a micro-grid
  - **Demonstration Project of Regional Power Grids with Various Renewable Energies**
  - **Demonstration Project on Renewable Energy Network Systems**