Wege zum Einbinden von öffentlichen Microgrids in das Netzmanagement – Erfahrungen aus dem Nice Grid Projekt

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Combined experience in providing advanced energy solutions

Over 200 years
Today

GLOBAL POPULATION: 7.3 billion

In the US 72 GW of generation capacity has or is set to retire – enough to power 44.7 million homes.

More than 620 million people in Sub-Saharan Africa live without power.

Extreme weather events are costing the global economy more than $200 billion annually.

“Always-on” digital economy is driving the need for more resilient and reliable power supply.

Source: NASA/DMSP, World Energy Outlook, Institute for Energy Research, World Bank, Brookings Institute
2040

GLOBAL POPULATION: 9 billion

INCREASED RENEWABLES MIX
CLEAN RENEWABLES will account for 54% of the GLOBAL POWER GENERATION CAPACITY

AFFORDABLE & EFFICIENT POWER
SOLAR COST WILL FALL BY 48% TO POWER DEVELOPMENTS

IMPROVE GRID RELIABILITY
438GW OF DISTRIBUTED POWER to be installed globally FOR IMPROVED GRID RELIABILITY

WORLD ENERGY DEMAND set to GROW BY 78% BY 2040

GE’S MISSION: TO INVENT THE NEXT INDUSTRIAL ERA, AND BUILD, MOVE, POWER AND CURE THE WORLD

Imagining the things others don’t / Building the things others can’t / Delivering outcomes that make the world work better

2014 Revenues

ENERGY MANAGEMENT ~$11B
POWER & WATER ~$30B
RENEWABLE ENERGY ~$9B
OIL & GAS $18.7B
HEALTHCARE $18.3B
AVIATION $24B
TRANSPORTATION $5.7B
CAPITAL $42.7B
APPLIANCES & LIGHTING $8.4B
WE ARE GE ENERGY
MANAGEMENT
GE’s Electrification and Automation Business

We are 47,000 people serving more than 150 countries.

We bring the world reliable, efficient energy.

We enable utilities and industry to efficiently manage electricity from the point of generation to the point of consumption.

We deliver outcomes that make the world work better.
Grid Solutions

Grid Solutions, a GE and Alstom joint venture, is serving customers globally with over 20,000 employees in around 80 countries. Grid Solutions equips 90% of power utilities worldwide to bring power reliably and efficiently from the point of generation to the end power consumers.

- Helping to meet growing energy demands
- Improving grid resiliency and energy efficiency
- Upgrading and digitizing aging infrastructure
- Enabling renewables and a diversified energy mix
Advanced products and services

**Power Electronics**
- High Voltage DC
- Flexible AC Transmission Systems
- Industrial DC Substations
- Energy Storage

**High Voltage Equipment**
- Transformers
- Gas Insulated Substations
- Air Insulated Substations
- Capacitors & Reactors

**Automation & Protection**
- Protection & Control
- Substation Automation
- Communications & Metering
- Monitoring & Diagnostics

**Software Solutions**
- Distribution & Outage Management
- Energy Management Systems
- Geospatial & Mobile Solutions
- Gas & Pipeline Management

**Projects & Services**
- Turnkey Projects & Consulting
- Electrical Balance of Plant
- High Voltage Substations
- Maintenance & Asset Management
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Agenda

1. Utility owned public microgrid
2. Nice Grid functional architecture
3. Available Flexibilities in the Grid
4. DSO Use Case: « Load reduction »
5. TSO Use Case: « Load reduction »
6. Microgrids per MV feeder
7. Results from Winter 2014/2015
8. DSO Use Case: « Massive insertion of PV »
9. Microgrids per MV/LV substations (or multiple of those)
10. Results from Summer 2015
11. Demo Screens
Nice Grid Use Cases on a Map

PV Area
- 550 Linky clients
- 150 kWp installed

Islanding area
- 12 Industrial clients
- 420 kWp installed

Customer Behavior
- 2,500 Linky clients

Battery location

Locations:
- Cailletiers
- Pesquier
- Colombie
- Rosemarines
- Lou Souleou
- Plaine 1
- Docks Trachel
Utility owned public microgrid

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Classic Microgrid</th>
<th>Utility owned, public Microgrid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Border</td>
<td><strong>Fixed;</strong> defined by the owner and/or the grid structure</td>
<td><strong>Dynamic;</strong> defined by the DSO depending on the forecasted grid constraints (introduced through renewable production)</td>
</tr>
<tr>
<td>Goal</td>
<td>Optimizing the local production and demand</td>
<td>Provide flexibility in order to help <strong>reducing of grid constraints</strong> at the microgrid boundaries.</td>
</tr>
<tr>
<td>Who operates</td>
<td>Microgrid operator</td>
<td>The DSO operates the <em>multiple microgrids</em> with its Network Energy Manager. In each microgrid <em>aggregators</em> operates its <em>portfolio</em> of flexibilities / customers following his own objectives.</td>
</tr>
<tr>
<td>Who owns</td>
<td>Microgrid owner</td>
<td><strong>Public utility</strong> <em>(DSO)</em></td>
</tr>
</tbody>
</table>
Nice Grid functional architecture

Flexibility Demand

Optimization and Management for DSO

Distributed Energy Resource Management System (DERMS)

Portal

TSO Flexibility Demand

DSO Flexibility Demand

Flexibility Offers

B2B Aggregator

B2C Aggregator

Network Battery Aggregator

Production Forecasts D-1

Consumption Forecasts D-1
Available Flexibilities in the Grid

Supply (Aggregator) + Industrial Customers

LES EXPÉRIMENTATEURS, C'EST VOUS !

Grid operator + Storage

Electric heating Self-organized demand reduction

EDF

DÉS CET HIVER, PARTICIPEZ À LA MAÎTRISE DES PCS DE CONSOMMATION ÉLECTRIQUE ET À LA RÉDUCTION DES ÉMISSIONS DE CO₂, RÉALISEZ DES ÉCONOMIES ET BÉNÉFICiez DE CHÈques CADEAUX

SMS

1 MW, Medium Voltage

33 kW, Low Voltage

4 kWh, Low Voltage

OLTC
DSO Use Case: «Load reduction»
Reason: Scheduling for an outage – Violation of transformer rating during peak periods

Normal situation

Carros: 20 MVA max
12 MW
5 MW
5 MW
CL-f1
2 MW

Lingo: 20 MVA max
12 MW
5 MW
5 MW
CL-f2
2 MW

Outage situation

Carros: 20 MVA max
24 MW
5 MW
5 MW
CL-f1
2 MW

Lingo: 20 MVA max
0 MW
5 MW
5 MW
CL-f2
2 MW
TSO Use Case: « Load reduction »
Reason: Violation of N-1 security criteria
Microgrids per MV feeder

- 10YFR-CL1------5  BASTIE
- 10YFR-CL2------Y  SPIROTECHNIQUE
- 10YFR-CL3------Q  TELEMECANIQUE
- 10YFR-CL4------I  FERRIER
- 10YFR-CL5------A  SAFT: BATTERIE POSTE SOURCE

- 10YFR-CL6------2  SEUIL 6

- 10YFR-CL7------V  POMETE
Results from Winter 2014/2015

France

Primary substation Carros

3 aggregators

20/01/2015
Results from Winter 2014/2015

Load reduction for the 3 aggregators on 20/01/2015

- **B2B**
  - Pmax 500 kW (500 kWh)
  - 6 sites

- **NBA**
  - 1.4 MW Pmax reduction
  - -900 kWh from 6pm à 8pm

- **B2C**
  - Pmax 900 kW (350 kWh)
  - 3 batteries
DSO Use Case: « Massive insertion of PV »
Reason: Low load & high generation – Violation of voltage constraints in MV and LV network

Source: ERDF
Microgrids per MV/LV substations (or multiple of those)

P_{\text{max}} \quad 50 \text{ kW}
Results from Summer 2015

Residential customers with off peak hours from May to July 2015

Residential customers with water boiler controlled from May to July 2015
Demo screens
DSO UI > Technical Aggregation View
DSO UI > Power Flow View
TSO UI > Intraday Offer Activation
DSO UI > Commercial Aggregation View
DSO UI > Resource View
Outlook

Partners have agreed to run 2 additional experiments (Winter 2015/16 and Summer 2016)

www.nicegrid.fr

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