Managing Distributed Energy Resources

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May 20, 2019
Distributed Energy Resources
The Disruption of the Grid

**Traditional Grids: One-way Flow**
- Centralized generation
- Passive Customer consumes
- Only a portion of grid remotely managed: HV & MV
- Electrons flow down, revenue flows up

**The DER Disruption: Multi-directional Exchanges**
- Distributed generation, storage & flexible demand
- “Prosumer” generates, stores & steers consumption
- Need remote management of all wires length: Down to LV
- Microgrid/P2P threatens dependency on electric utility
**DIGITAL ENERGY**

**Distributed Energy Resources (DERs)**

*Are your teams/tools/processes ready for New Paradigms?*

**Awareness: what is the « load »?**
Now need to be precise: native consumption, « hidden » load, or net load?

**Powerflow: « Backfeeds »**
Energy flow going up the Voltage levels instead of going down

**Dynamics: Intermittency**
Voltage increasing (instead of decreasing) alongside a feeder

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Grid Operations before DERs

**GIS - Planning**
- Managing register of own Assets
- Accepting Y/N new load connections
- Planning investment (load growth scenario, APM strategy, etc.)

**ADMS**
- Operating the D-grid in Real-time
- Substation Automation. Protection, interlock

**EMS**
- Operating the T-grid in Real-time
- Operating the T-grid in Look-ahead
- Scheduling gen via Markets

**Market Operator**
- Running the market for T

**GMS**
- Generator: Selling wholesale energy.
- Retailer: Buying wholesale energy, selling retail

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End-to-End DER Orchestration

**GIS - Planning**
- **Grid Asset Manager/Planner**
  - Managing register of own Assets + DERs (tech. + contract attributes)
  - Accepting Y/N new load/DERs connections
  - Planning investment (load/DER growth scenario, APM strategy, etc.)
  - System Stability Limits

**ADMS**
- **Look-Ahead**
- **Real-time**
- **D-grid Operator**
  - Operating the D-grid in Real-time w/ DER-ready analysis/control
  - Operating the D-grid in Look-ahead
  - Scheduling DER flex via Markets
  - Sometimes self-aggregates DERs

**AEMS**
- **Look-Ahead**
- **Real-time**
- **T-grid Operator**
  - Operating the T-grid in Real-time
  - Operating the T-grid in Look-ahead
  - Scheduling gen and flex via Markets
  - Managing bulk Renewables
  - Synchronizing on DER at T/D interco
  - Sometimes self-aggregates DERs
  - Fast Frequency Response
  - Wide Area protection scheme
  - Oscillation management

**MMS**
- **Running the market for T**
- **Coordinating flex transactions [T + D + Aggr + P2P]**

**Market Operator**
- Generator: Selling wholesale energy.
- Retailer: Buying wholesale energy, selling retail
- Enriching their portfolio/offering w/ DER flex

**GMS**
- Substation Automation. Protection, interlock. Local forecast, optim, control
- DRMS/DERM for Aggregation by DSO or TSO
- Microgrid mgt

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DER Challenges & Solutions
End-to-end Product Capability

GE DER MGT SOLUTION = GIS+PLANNING+ADMS+EMS+MMS

DISTRIBUTED INTELLIGENCE
• What can shouldn’t we do on the edge?

OPTIMIZATION
• Which levers (DERs, others)? When?

FORECASTING & PLANNING
• What’s at and behind the meter? What can I anticipate in the next hours?
• What more can I take where?

DER-AWARE GIS & ADMS
• Where are the DERs and how do they behave? Foundational.
Look-ahead Grid Operation – From Reactive to Predictive

Monitoring & Acting in Real-time is Not Enough Anymore – Need to Anticipate

ADMS or EMS

Look-ahead

Real-time

The ADMS / EMS Operator

Splitting their day between managing today and preparing for tomorrow
Look-ahead Analysis – Principles

From Weather Forecast to Look-ahead Grid Reliability Study

What will the **weather** be like in the next 24 hours?

What will the **load and wind/PV generation** be like in the next 24 hours?

What will the **electrical flows** (W, VAr, V, Amps) be like in the next 24 hours?

Will I face violations?

Forecasting

- Weather Forecast
- Weather History
- Load History
- Distributed Generation History

Load Forecast
- Distributed Generation Forecast

Grid **Look-ahead Reliability Analysis**
- (manually for one time slot in study-mode or automatically for a typical 24h look-ahead window)

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Challenges

• Generators want to connect quickly

But

• Generators have highly variable output
• Stresses networks, risk of overloading/damaging assets

Solution: DSO offering Generators an alternative Connection scheme:

• Less connection delay
• Cheaper connection

Adaptive Network Management

vs

• Generators accept some curtailment when grid security requires it

Maximizing existing grid hosting capacity

Regulatory dependent (priority, compensation, reporting)
DERM > Why GE?

• **Experience delivering with Utilities pioneering DERs** (Hawaii, California, Ireland, Denmark, etc.) – both pilot and operational projects

• **Experience delivering on the full DER value chain** (DERM for DSOs, Renewables Management for TSOs, DRMS/DERM for aggregators, microgrids, DER integration grid planning, LV Management)

• **Best combination of Transmission and Distribution expertise, essential in DERM** where TSOs and DSOs need to collaborate, and where T level concepts migrate to D level (forecasting, look-ahead, scheduling, transactions/markets)

• **Modular Applications and Common Data layer strategy** - essential in DERM to address DER in all utility business processes and adapt to evolving regulatory regimes

• **Offerings and solid roadmap to manage DERs in an end-to-end fashion**, in and across GIS, planning, ADMS, EMS, MMS, at aggregator and microgrid level

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