Argonne
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BEYOND DERMS:
GOING BEYOND TO MANAGE FUTURE POWER GRIDS

Creating new tools to meet the challenge of managing millions of new smart energy devices while focusing on grid resiliency and energy savings.

THE CHALLENGE

Explosive growth in new distributed energy resources (DERs)—solar panels, wind turbines, batteries, electric vehicle charging stations, water heaters, HVAC systems—needs new power system integration tools that go beyond the current Distributed Energy Resource Management Systems (DERMS).

These power system tools are needed for power grid managers to integrate millions of power devices into local grids and for DER owners to use power generated from DER devices to lower their utility electric bills or sell excess electricity to utilities when the grid needs more power.

THE BENEFITS

Beyond DERMs integrated power system platform helps power grid managers and DER owners by:

☐ Enabling integration of millions of "internet of energy" technologies to manage power systems as a whole and respond to events

☐ Finding ways to manage power systems while enabling DER owners to earn revenue for providing power services to the grid, and helping consumers save energy costs.

THE CAPABILITIES

Beyond DERMS platform now delivers new capabilities and uses, including integrating planning functions and delivering grid services for:

☐ Peak load reduction to mitigate generation and transmission capacity costs.

THE IMPACT

Results showed that core Beyond DERMS concepts are feasible and motivate the need for a large-scale demonstration project to demonstrate how DERMS fits with other keygrid modernization elements such as Advanced Metering Infrastructure, DER and aggregations applying microgrid concepts. The Beyond DERMS technology was recently acquired by U.S. DERMS provider, EnergyHub, enabling greater impact on the U.S. electricity industry.

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What does going Beyond DERMS mean?

- **Using modern "serverless" cloud software** that can respond to specific events without needing to manage computer servers to run codes and connect AMI (advanced metering infrastructure), SCADA (supervisory control and dataacquisition), microPMUs (micro-phasor measurement units), and engineering network model data into Beyond DERMs platform.

- **Developing local "data agents" to locally communicate** with utility data systems and securely transfer data to cloud-based DERMS. IoT messages from devices trigger sets of code, which then runs calculations, records data in databases, and responds to devices based on grid conditions.

- **Testing functions on integrated Beyond DERMs platform** by using devices/data streams from over 300 smart energy devices, 1000s of simulated devices and data from over 20,000 smart meters connected on distribution networks of utility partners, including Vermont Electric Cooperative and Burlington Electric Department.

- Load shaping (ex. energy price arbitrage) to reduce wholesale energy purchase costs to supply time-varying loads.

- Distribution network management services through software systems modeling and managing network constraints in real time (in simulation).

- Ancillary services for balancing authorities, independent system operator or regional transmission organization (in simulation).

- Resilience for consumers and the grid as a whole for consistent delivery of electricity service.

- Integrating economic analysis tools that facilitate DER project planning.

- Integrating weather, load and DER forecasting to demonstrate how wider ranges of DERs can provide flexible grid services.

- Supporting more advanced use cases including Ancillary Services, Black-Sky-Day Operation and Mode Switching.

NEW TOOLS

Beyond DERMS platform connects grid operators, DER owners and their devices with three key functions:

- **Beyond DERMS dashboard for utilities.** Helps electricity grid operators visualize and manage how DERs operate to provide grid services.

- **Beyond DERMS mobile app for DER owners.** Allows DER owners (home/business owners) to connect their DERs and manage how those devices interact with the grid.

- **Beyond DERMS backend Internet of Things (IoT) platform.** Allows devices to interact with the platform in real time to coordinate the behavior of millions of devices and uses Packetized Energy Management (PEM) as foundation for IoT system.

PARTNERING WITH INDUSTRY

Argonne partnered with Packetized Energy in the multi-year build of Beyond DERMS platform in three phases:

- **Phase 1**: built Beyond DERMS platform to integrate planning functions and deliver power grid services.

- **Phase 2**: added DER capabilities by integrating weather, load, DER forecasting, and economic analysis.

- **Phase 3**: demonstrated advanced use cases.

GRID-INTERACTIVE BATTERY DEMONSTRATION

Beyond DERMS project team tested a Black-Sky-Day (or black-out) use case to demonstrate how Beyond DERMS platforms connecting DERs such as grid-connected batteries can enable DERs to have "good reflexes" to respond to local and regional grid problems and mitigate blackout risk.

Home battery systems (i.e. rooftop solar panel systems and community microgrids using community-scale battery systems paired with solar) can help power homes, schools or hospitals when bulk power grids fail.

When risks of cascading failures are high, grid operators can send emergency ramping signals to rapidly reduce load or generation to DERs that can react (in seconds) to balance signals from bulk grids.

The Beyond DERMs project team tested this use case by:

- Connecting Beyond DERMs platform to home battery system with residential-scale inverter and small Wi-Fi enabled microcontroller to communicate with the inverter via MODBUS protocol.

- Conducting a simple test where DERMS sent a message to the battery controller to initiate a discharge event and subsequent charge event.

- Determining that this type of remote grid management is indeed feasible.