

The CERTS Microgrid

BNL Smart Grid Workshop

October 8-9, 2015

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Defining Microgrids

DOE's Microgrid Definition

- A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode.

Key Attributes

- Grouping interconnected loads and distributed energy resources
- Can operate in both island mode or grid-connected
- Can connect and disconnect from the grid
- Acts as a single controllable entity to the grid



CERTS Microgrid R&D Research Program

Objective

- To lower the cost and improve the performance of clusters of smaller distributed energy resources and loads when operated in an integrated manner, i.e., as microgrids

Approach/Implementation

- Vendor-independent (plug and play), no requirements for fast communication
- Design, simulation, bench-scale testing, fabrication of pre-commercial prototypes, full-scale testing at AEP, field demonstrations

Research Outcomes

- Design guidelines for integration of mixed source operated as microgrids
- Licensed IP in commercial products



Microgrids vs. CERTS Microgrids

A **microgrid** is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode.

—Microgrid Exchange Group, October 2010

- Distinguishing features of the **CERTS Microgrid Concept**:
 - Seamless islanding and reconnection via single PCC
 - Peer-to-peer, autonomous coordination among micro-sources (w/o high bandwidth communications)
 - Plug-and-play - no custom engineering
 - Energy manager on arbitrary platform
- Distinguishing features of the **CERTS Microgrid Test Bed Demonstration**:
 - Small sources (<100 kW each)
 - No stand-alone storage (yet)
 - No power flow onto the grid



CERTS Microgrid R&D Program

Microgrid Element	Design, Simulation and Bench-scale Lab Testing at UW	Fabrication and Factory Acceptance Testing	Field Commissioning at AEP/CERTS Microgrid Test Bed	Mixed System Tests at AEP/CERTS Microgrid Test Bed
Tecogen InVerde	2010	Winter 2011-12	Summer/Fall 2012	Winter 2012/3
Synchronous Generator	2011	Fall 2012	Fall/Winter 2012	Winter 2012/3
Intelligent Load Shedding	N/A	Summer 2013	Spring 2014	Fall 2015
Storage	2012	Winter/Spring 2014	Summer 2015	Summer/Fall 2015
Stressed (degraded) Operation/ Restoration	2014-2016	N/A	N/A	Fall 2015-2016
PV- Wisconsin Energy Institute	2016-2017	TBD	TBD	TBD



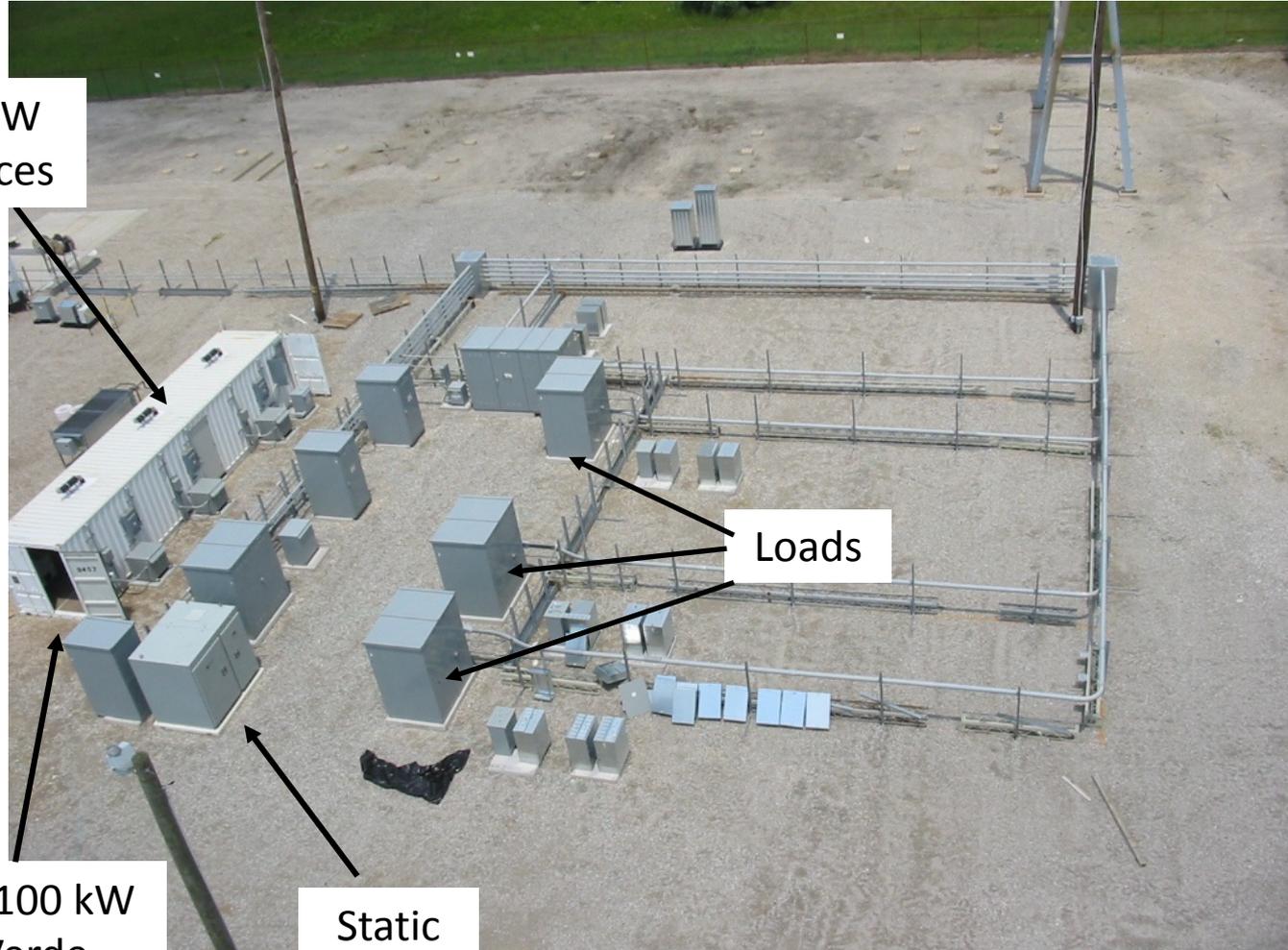
AEP/CERTS Microgrid Test Bed



60 kW Sources



ew 100 kW InVerde



Loads

Static Switch



CERTS Microgrid: Commercial Application

When a disturbance to the utility grid occurs, the automatic disconnect switch enables the facility to "island" itself from the main utility grid and independently generate and store its own energy.

Utility power enters the facility at the "Point of Common Coupling"

PG&E utility interconnection or "Point of Common Coupling" and static disconnect switch



Two 1.2 MW backup diesel generators



Distributed Energy Resources Management System (DERMS)



The distributed energy resources management system (DERMS) serves to reduce peak demand during normal grid-connected operation or during a demand response event.

1 MW fuel cell



2 MW advanced energy storage system



Five 2.3 kW wind turbines



Facility Electric Load

Facility Electric Load

1.2 MW rooftop solar photovoltaic system



Santa Rita Jail Demonstration Project



CERTS Microgrid: Technology Transfer



InVerde[®] 100

Features & Benefits

- 100 kW Continuous / 125 kW Peaking
- Standardized Interconnection
- **Black Start Grid-Independent Operation**
- **Microgrid compatible with licensed CERTS¹ power balancing control software**
- Premium Quality Wave Form, Voltage and Power Factor for Special Applications (e.g. computer server farms or precision instrumentation)
- Power Boost for Demand-Side Response
- Enhanced Efficiency from Variable Speed Operation
- Simplified Inter-Unit Controls for either Mode of Operation (parallel or standby)
- ETL Listed - Labeled for compliance with UL 1741 - Utility Interactive; Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources
- **Renewable Energy Compatible, a Clean Energy Solution for Today and Tomorrow**

¹CERTS - Consortium for Electric Reliability Technology Solutions



TECOGEN, Inc.

- Over 25 years experience in packaged cogeneration, chillers and refrigeration systems
- More than 1,400 operating units in the field
- Extensive service network with factory-trained technicians exclusively servicing Tecogen products



Microgrids as a Resiliency Resource



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By Lyn Corum

The Brevoort—a 20-story, 1950s-era co-op in the heart of Greenwich Village in New York City, NY—did not go dark when Superstorm Sandy struck Manhattan on October 29, 2012. All of the power on lower Fifth Avenue was lost, but the co-op stood bright among its dark neighbors, thanks to the 400-kW Tecogen natural gas-fired cogeneration system installed in 2010 that powered the entire building until Consolidated Edison’s power was restored five days later. The natural gas supply system was not affected by the storm.

The cogeneration system ran 24 hours per day for the five days, providing power to all apartments, the elevators, domestic water pumps, and heat for the central boilers and domestic hot water.



Combined heat and power (CHP) with microgrid technology provided the co-op building with critical electricity services during the week of utility outages caused by Superstorm Sandy



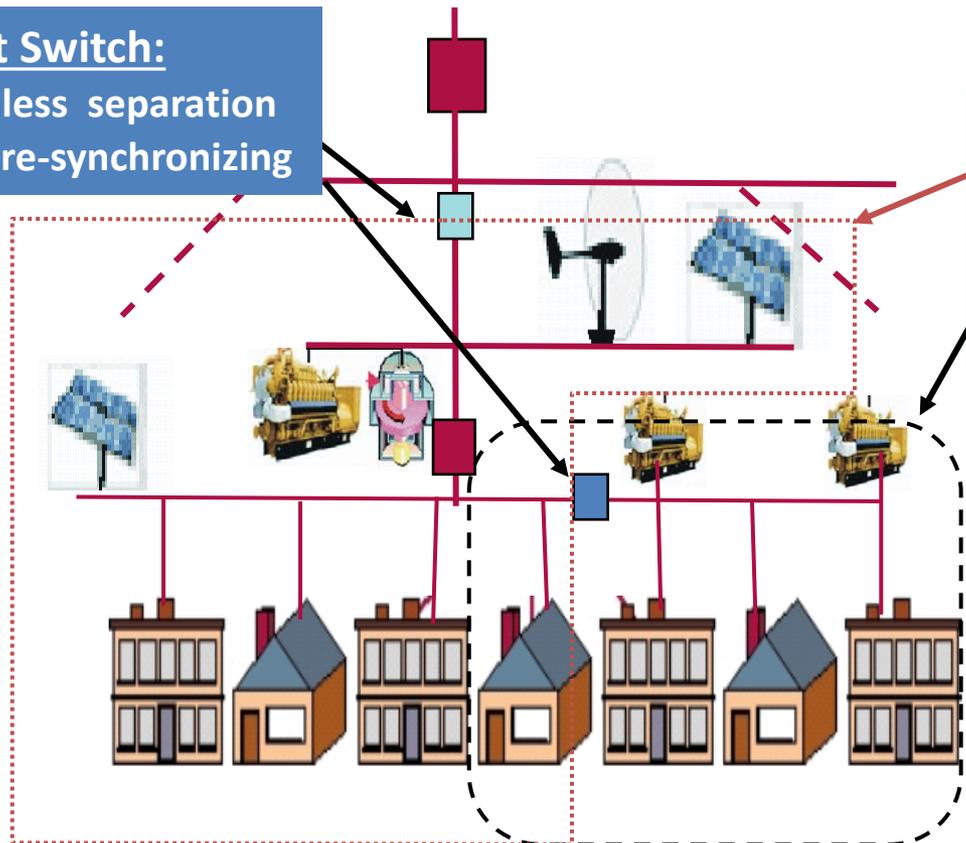
What's next: Coupled Microgrids

Smart Switch:

- Seamless separation
- Auto re-synchronizing

Two coupled microgrids:

- Distribution level
- Customer level with high *Local Reliability & CHP*



Standard building block for “Smart Distribution”



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