An Energy-Efficiency Workshop and Exposition
Orlando, Florida

Microgrid Testing at Sandia National Laboratories*

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Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000

Contents

- Definitions
- DETL Microgrid
- Microgrid Considerations
- Operational Data
- Conclusion

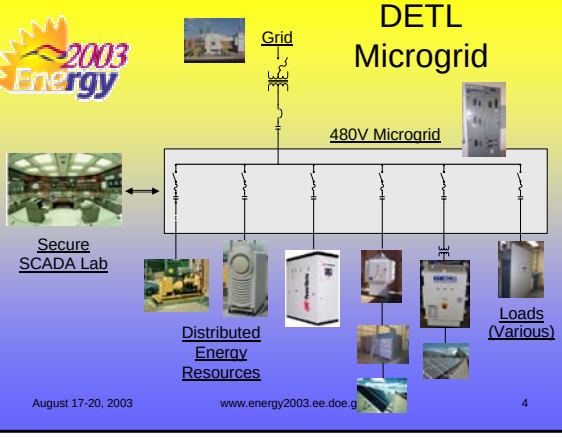
Definitions

Microgrid
collection of loads and energy sources capable of operating either grid tied or independently

Uninterruptible Power Supply (ups)
provides critical load power on loss of prime ac power (10- 30 minutes energy storage typical)

Distributed Energy Resources (DER)
power generation < 10 MW sited close to load

DETL Microgrid



DETL Activities

- Performance of evolving sources
  - Microturbines
  - Fuel cells
- Source interactions
- System controls
  - Grid tied dispatch/communications
  - Standalone capability

Hands-on DER Training for Federal Energy Managers

- FEMP FUNDED (no cost)
- Albuquerque Sept. 17 18
- More info at Sandia booth

Potential Microgrid Advantages

- Economic
  - Aggregation
  - Peak shaving
  - Combined heat & power
- Energy security/reliability ←Standalone
  - Diversity: fuel, resources
  - Reduce single point vulnerabilities
  - Physical security/controls

Operating Modes and Issues

Grid connected

➢*Grid follows load, regulates V & f*

- Issue: Utility ***interconnection*** requirements

Standalone

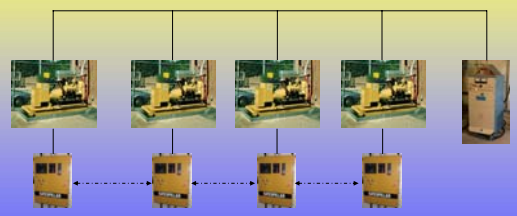
➢*DR follows load, regulates V & f*

- Issue: ***Load***-following

Load Following

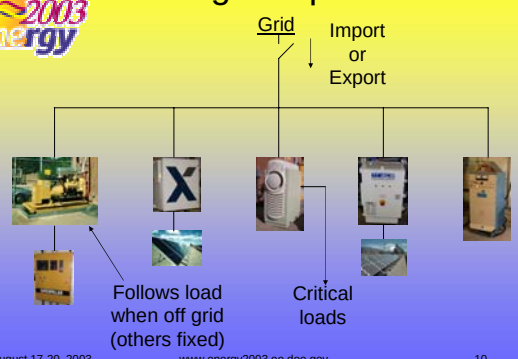
Gens can share W and var

•Droop (P vs. f, Q vs. V)

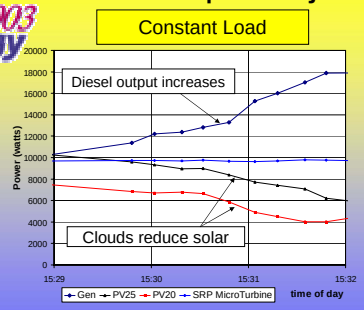


•Communications

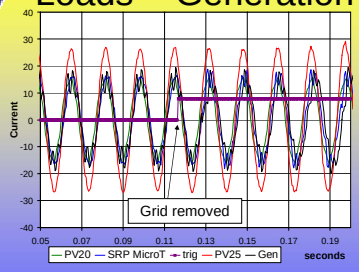
Microgrid Operation



Diesel Output Adjusts

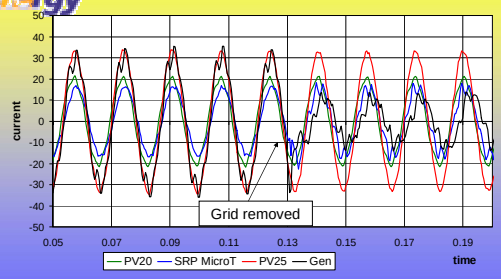


Loss of Grid Loads = Generation



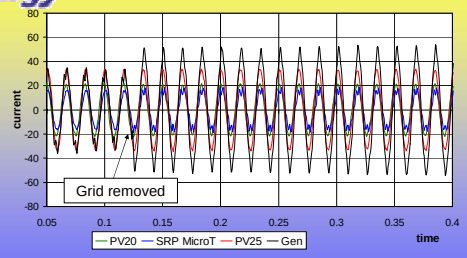
No import or export **No sources trip**

Loss of Grid
Loads < Generation



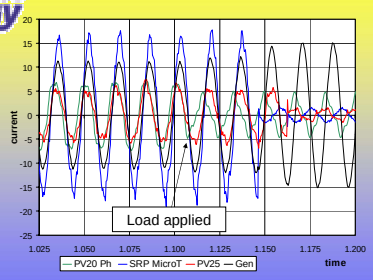
Exporting 13 kW **Microturbine & 1 PV Trip**

Loss of Grid
Loads > Generation



Importing 11kW **No Trips**

Standalone Block Load



17 kW block load **All but generator trip**

Microgrid Conclusion

- Security implies standalone capability
- Standalone operation challenging
  - Rotating machines can load share
  - Inverter-based may not (microturbines, fuel cells)
- Nuisance trips an issue
  - Load follower dynamic response critical
  - Energy storage (UPS) needed