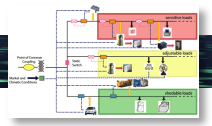
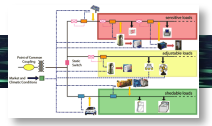


Santa Rita Jail CERTS Microgrid

WIDRC Meeting
Wisconsin Energy Institute
17 April 2015

Bob Lasseter
University of Wisconsin – Madison



Microgrid Development @ UW

- DOE 1999- 2002: Early concepts/proof-of-principle UW Lab
- CEC PIER 2001-2006: Design and construction of CERTS/AEP test facilities
- DOE RDSI 2006-2009: Phase-one testing at AEP (invert based DER)
- Six UW Patents: 2006-2011
- Tecogen markets InVerde 100kW autonomous CHP system
- DOE HQ 2010- present: Phase-two testing (NG gen-set, battery storage)
- 2012 Santa Rita Jail CERTS Microgrid Commissioned (S&C 4-MWhr battery)
- 2012 Tecogen CHP Greenwich Village Co-op operates through Hurricane Sandy.

Microgrid Significance and Impact

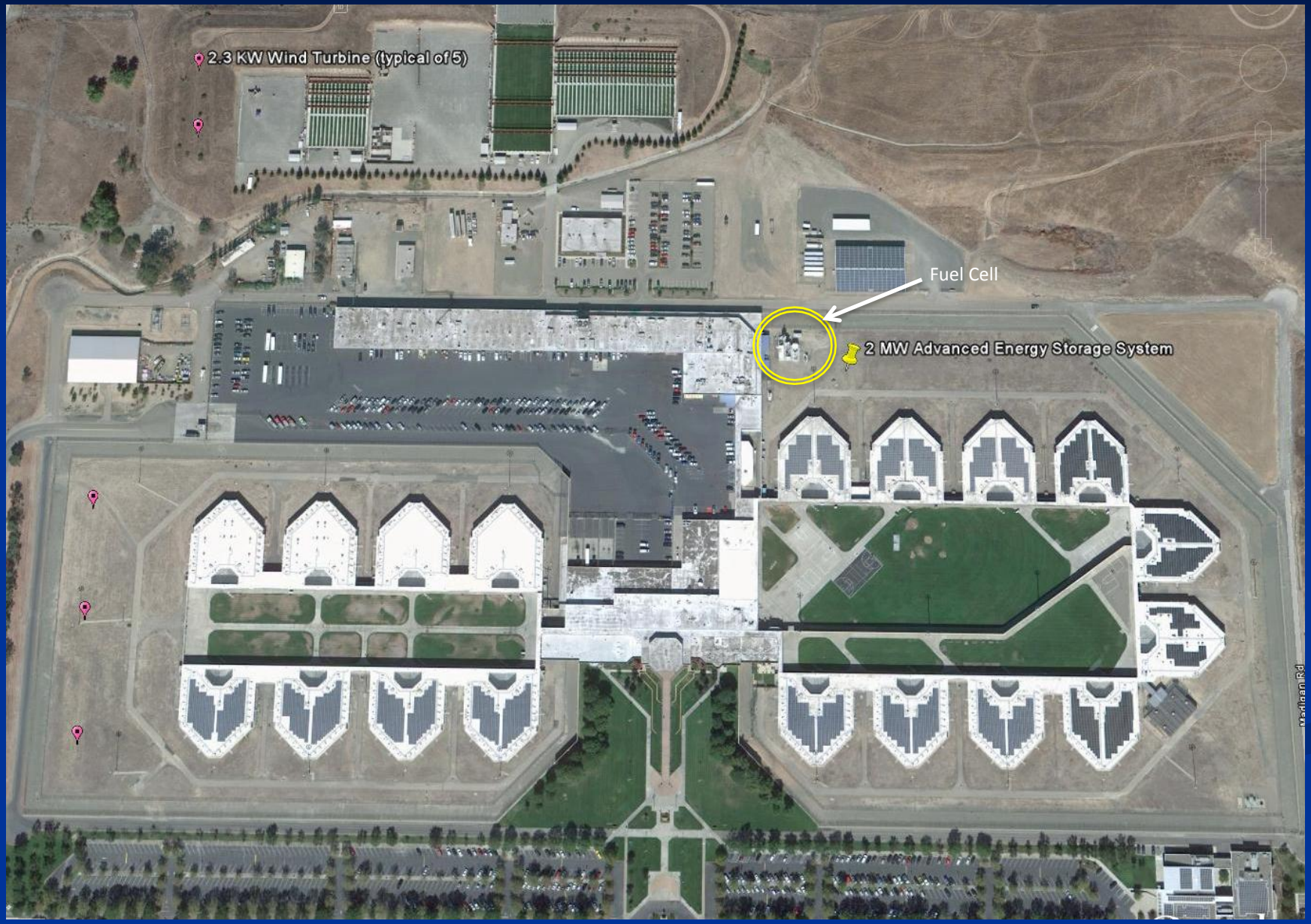
Microgrids can enhance the values that DER offers:

- *Customer benefits include:* bill savings, price certainty, reliability (including power quality), energy independence.
- *Grid benefits includes:* a well-behaved electrical "citizen" and a ancillary resource to the grid.
- *Societal benefits include:* more resilient local energy infrastructure and increased environmental benefits.

"The CERTS microgrid control technology is the most radical of all options-as well as the lowest cost-as it is embedded into a 100-kW CHP system offered by Tecogen"

Peter Asmus, "Distributed Generation," September/October 2011

Santa Rita Jail: Smart Grid



Alameda County,

Santa Rita Jail

Objective

- Demonstrate the commercial implementation of the CERTS concept
- Reduce peak electricity demand & demonstrate demand response
- Improve the security and reliability of the power supply
- Improve the fuel cell's performance

Equipment

- 4 MW-hr Lithium Ion battery (new)
- Two 1 MW diesel generators (modify)
- Smart switch (new)
- 1 MW fuel cell with CHP
- 1.2 MW solar on rooftops
- 12 kV feeder

DOE &CEC funded project

Santa Rita Jail:
SmartGrid (2011)

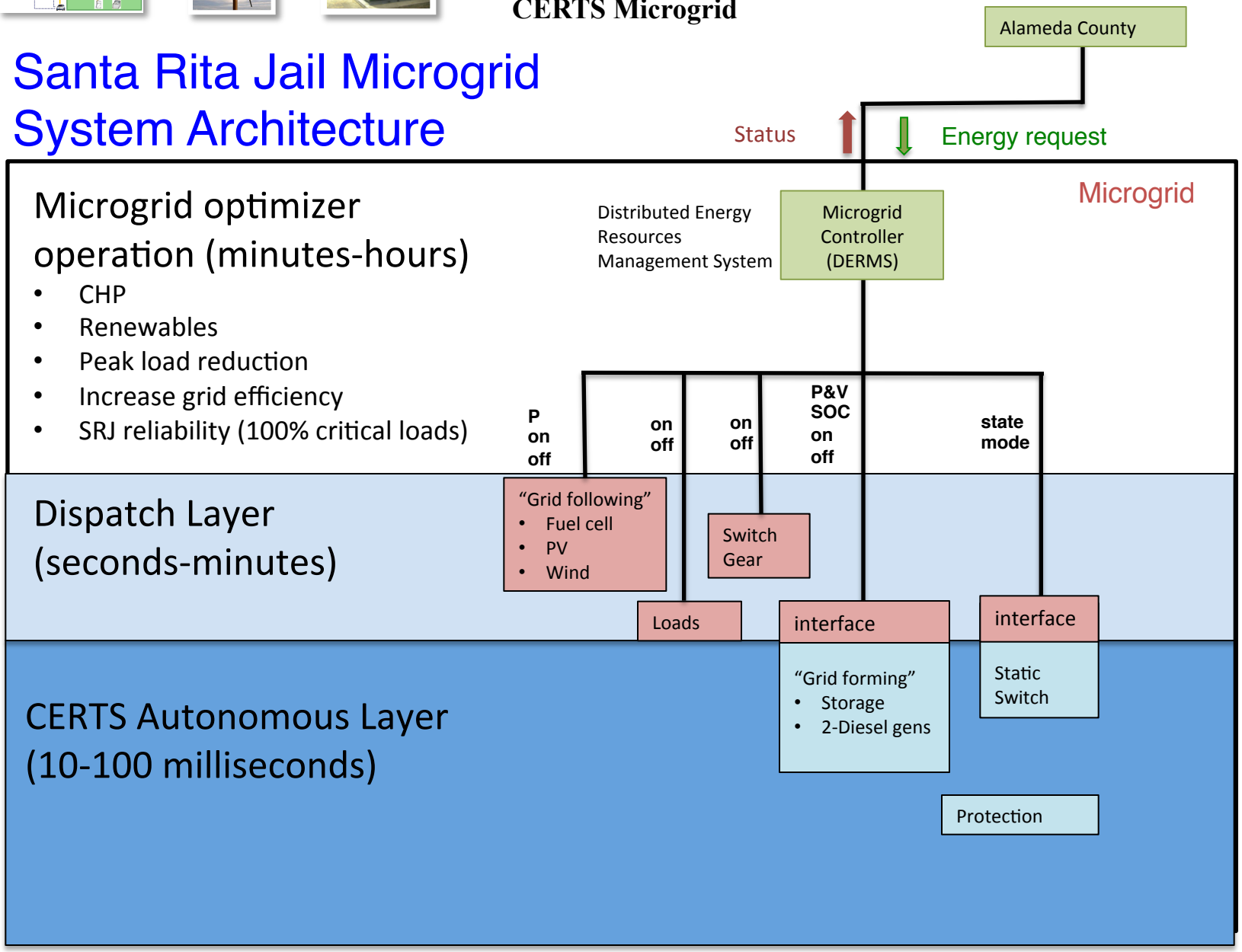
1.2 MW Solar PV (Existing)

12 KW Small Wind Turbines (New)

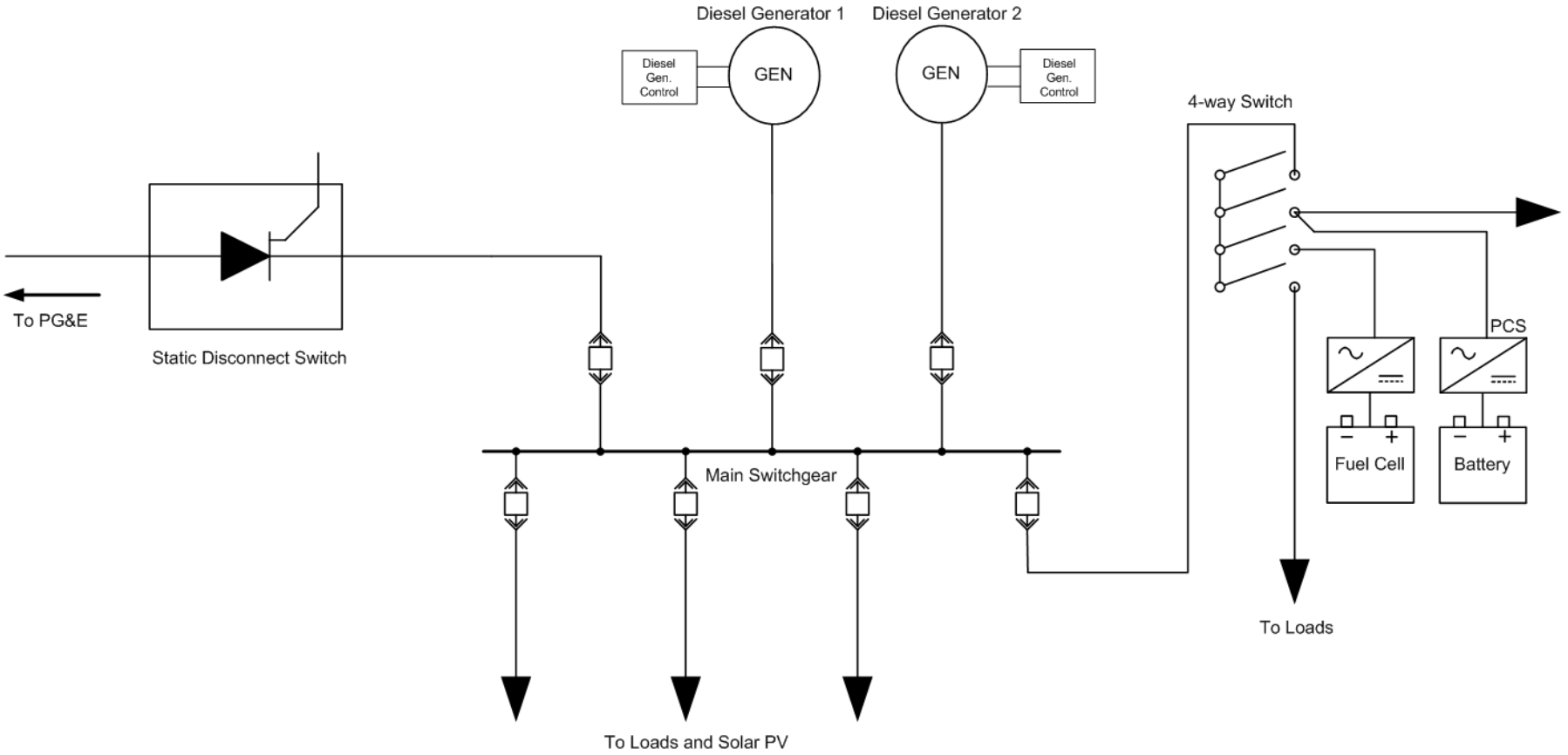
1.0 MW Fuel Cell (Existing)

2.0 MW Advanced Energy Storage (New)

Santa Rita Jail Microgrid System Architecture



Santa Rita Jail Simplified SLD

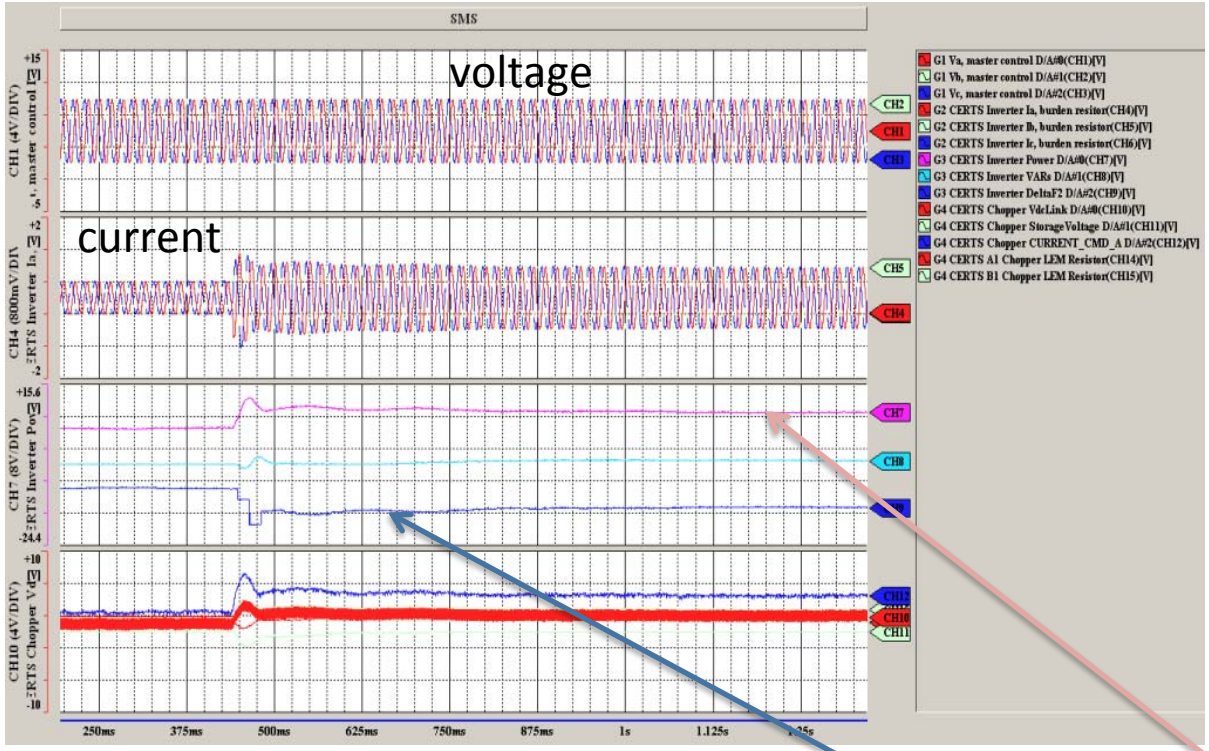


Energy Storage System

- Four 500 kW, 1MW-hr Lithium Iron Phosphate BYD battery enclosures
- BYD battery management system
- Two 1.25 MVA, 480 V S&C Electric Power Conversion System

S & C inverter Factory test 300kW step load

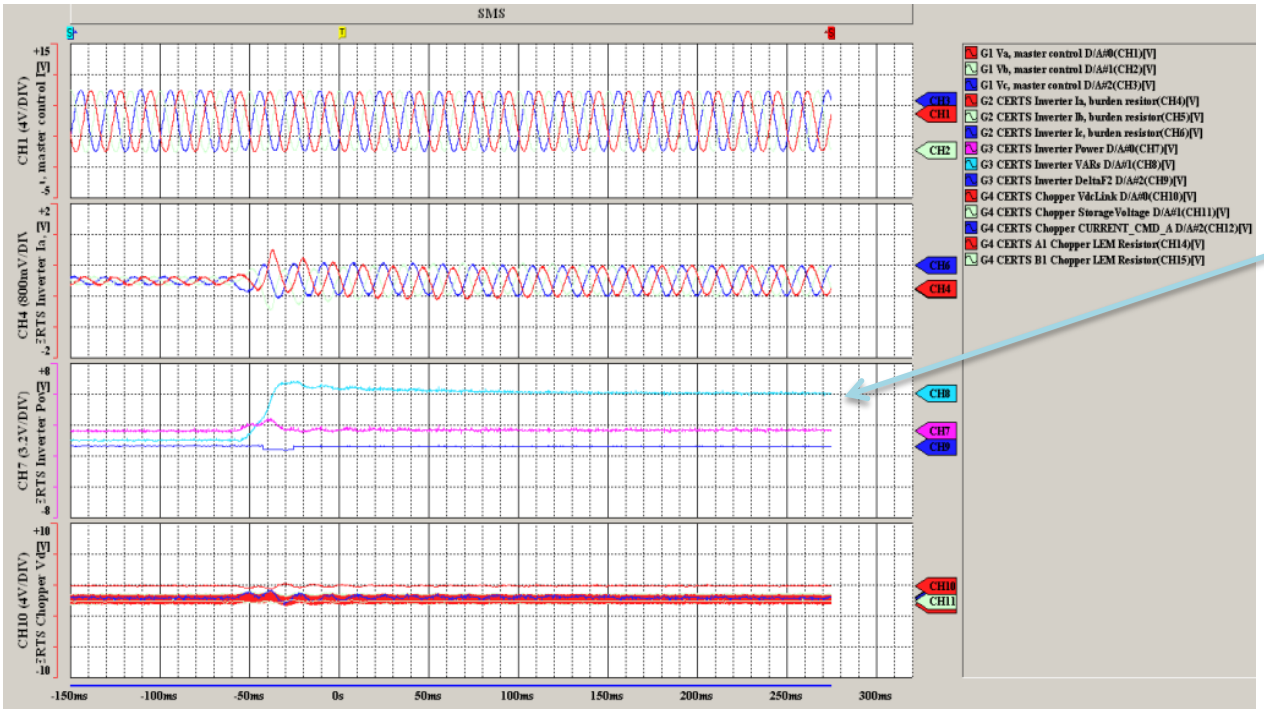
In islanded mode add 300kW of resistive load while connected to the Generator



Factory test performed on 1 MW storage system. The battery was emulated using a second 1 MW inverter. There is also a rented 500kW diesel generator operating at 1% droop.

S & C inverter Factory test 300kVAR step load

Add 300kVAR of inductive load while disconnected from the Utility with a 50kW resistive load

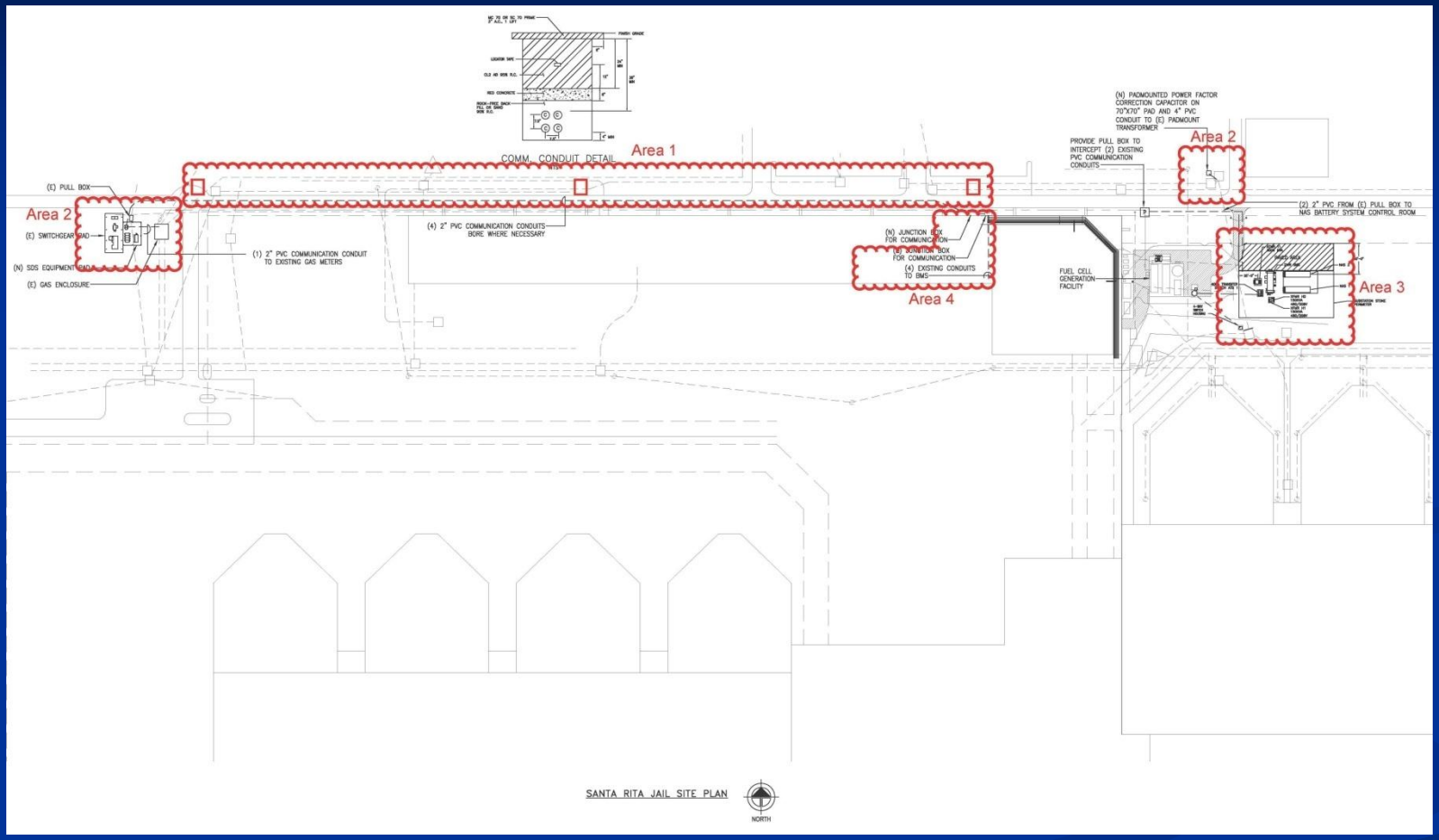


VARs

Energy Storage System

Santa Rita Jail: Smart Grid

Santa Rita Jail: Smart Grid



Area 1: Underground Communications Conduit
Area 2: Static Disconnect Switch

Area 3: Advanced Energy Storage & Power Conditioning System
Area 4: Generator Upgrade / Smart Grid Control System

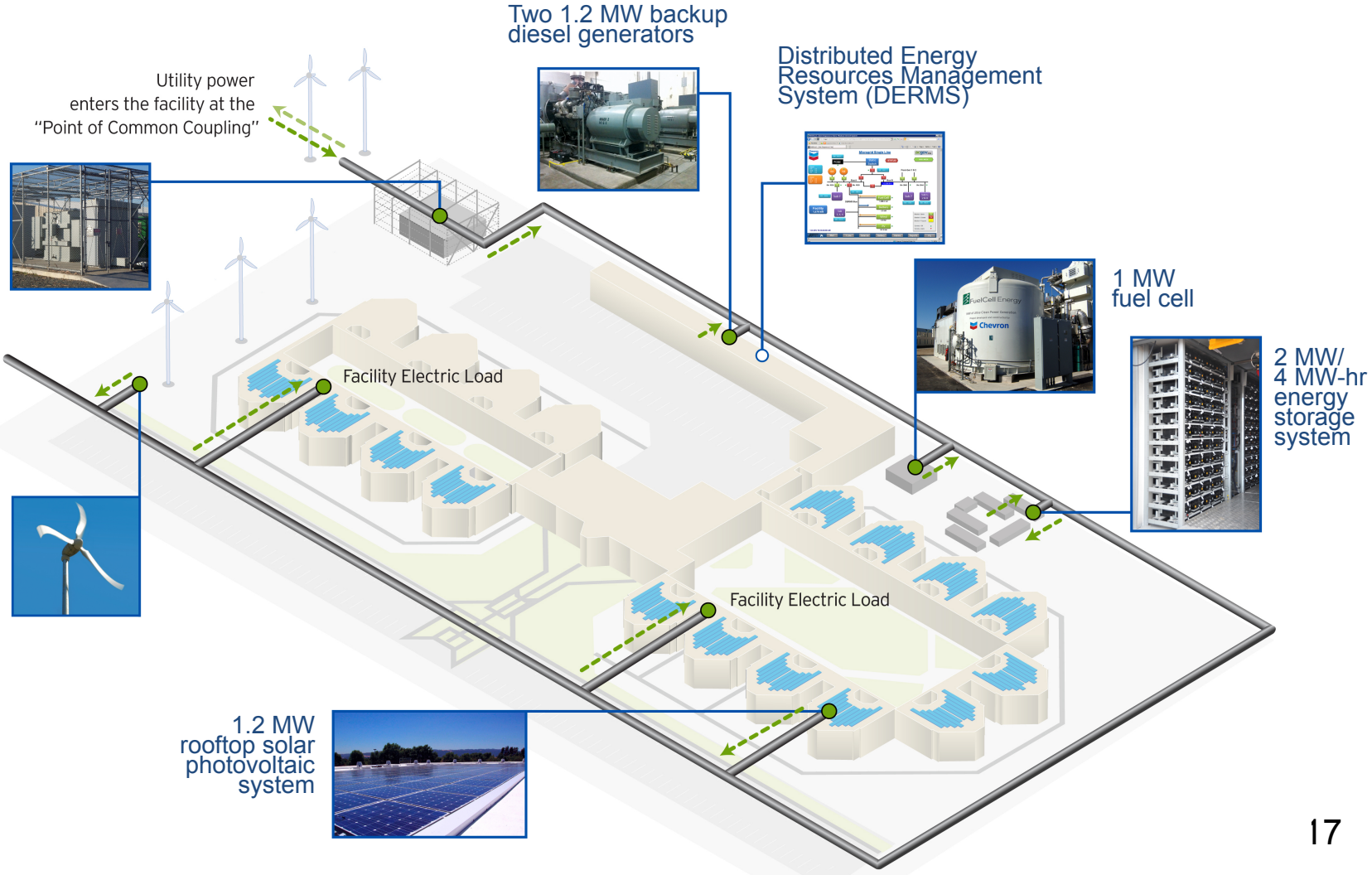
Santa Rita Jail: SmartGrid Construction Underway

Directional Boring of Underground Conduits

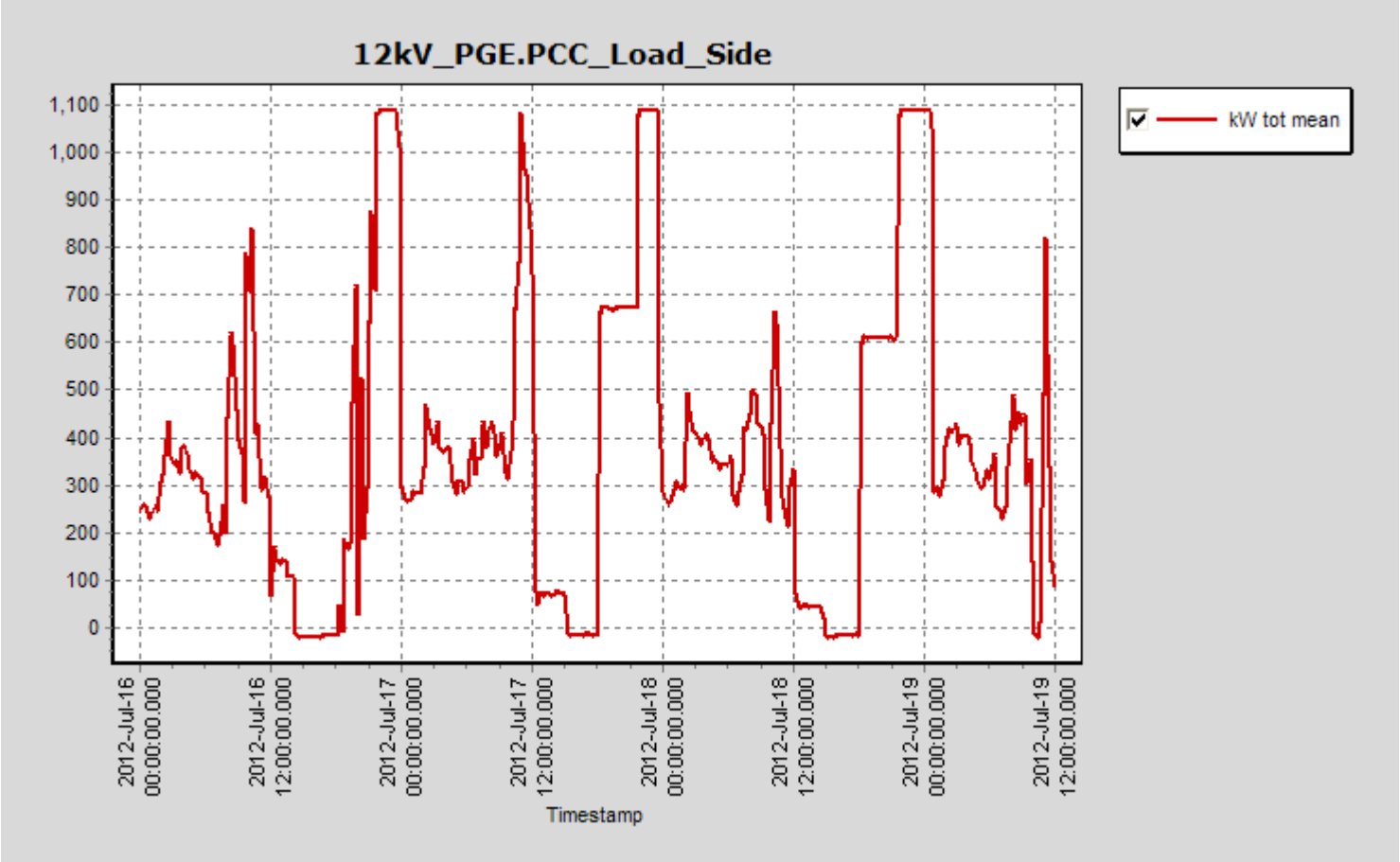

automatic disconnect switch

When a disturbance to the utility grid occurs, the automatic disconnect switch enables the facility to "island" itself from the main utility grid.

Santa Rita Jail Microgrid – in operation today



Utility PCC Power Flow (peak load 3.5 MW)



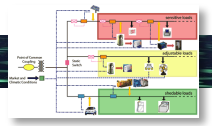
Smart Grid: Major Equipment

- **Static Disconnect Switch*:*** Enables Grid Islanding
- **Onsite Generation:** Including Photovoltaics, Wind, Fuel Cell, and Back-up Diesel Generators
- **Advanced Energy Storage/ Power Conditioning System:** Enables electrical load following and peak power shaving / demand response
- **CERTS Compatible Control and Monitoring System:** Enables Integration.

Conclusions

- The CERTS Protocol is a powerful tool for integrating distributed generation resources
- Battery trickle charge less accurate in CERTS mode than in current-source mode
- Utilities are more comfortable with static disconnect switches if used with conventional equipment
- Charge balance of Battery cells, strings and enclosures should be carefully managed
- Load and generation shedding scheme needed to balance microgrid generation and load

Eduardo Alegria, Lead Engineer
Chevron
July 30, 2012



Questions?

Simulation of Islanding with ES, PV & Fuel Cell