Microgrids from a Utility's Perspective

SDGE connected

A Sempra Energy utility™

A National Town Meeting on Demand Response and Smart Grid

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San Diego Gas & Electric

- Subsidiary of Sempra Energy
- **1.4** million electric meters (~900k gas meters) serve over **3** million people. Smart Meter deployment is complete.
- **4,500** employees support a territory covering **4,100** square miles in two counties and **25** cities.





- Transmission (69-500kV)
  - ~**1,800** mi overhead, ~**105** mi underground
  - Over **14,000** structures
  - **22** substations
  - **201** tie lines
- Distribution (12kV & 4kV)
  - ~**10,100** mi underground (60%)
  - ~**6,700** mi overhead (40%)
  - ~**280** substations
  - ~**1,000** circuits
  - ~**220k** wood poles

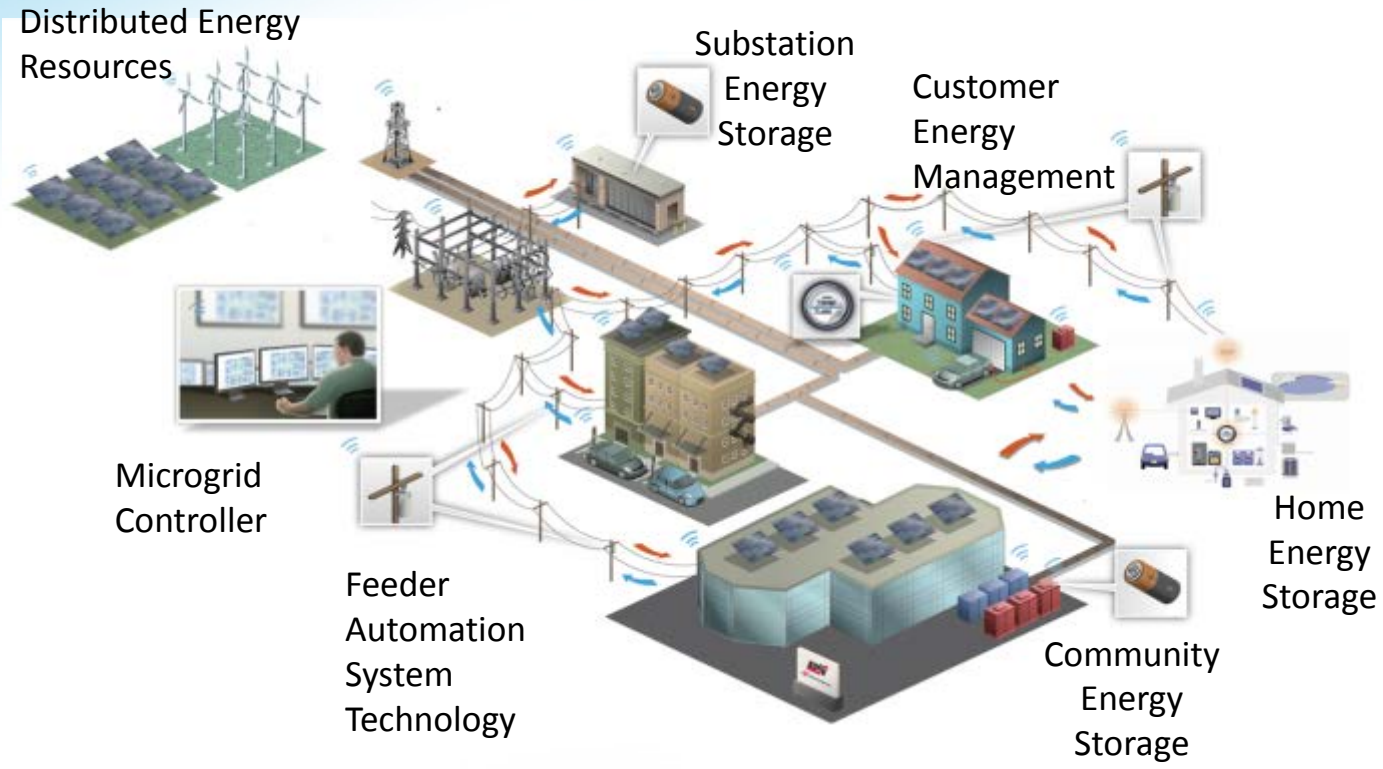
Types of Microgrids

Utility	• Entire circuit or substation • Borrego Springs
Military Bases	• Energy “surety” for critical loads • MCAS Miramar, Camp Pendleton, etc
Campus	• Utilize CHP to improve energy performance • UCSD, Princeton, etc
Greenfield Development	• Alternative service delivery model • Civita
Remote Villages	• Electrification of remote villages/islands • Necker Island
Homes	• Integration of DER, In-Home Technology and EV charging • Zero Net Energy homes (?)

Borrego Springs Microgrid Demonstration Project

Utilize advanced technologies to integrate and manage distributed resources within the Smart Grid

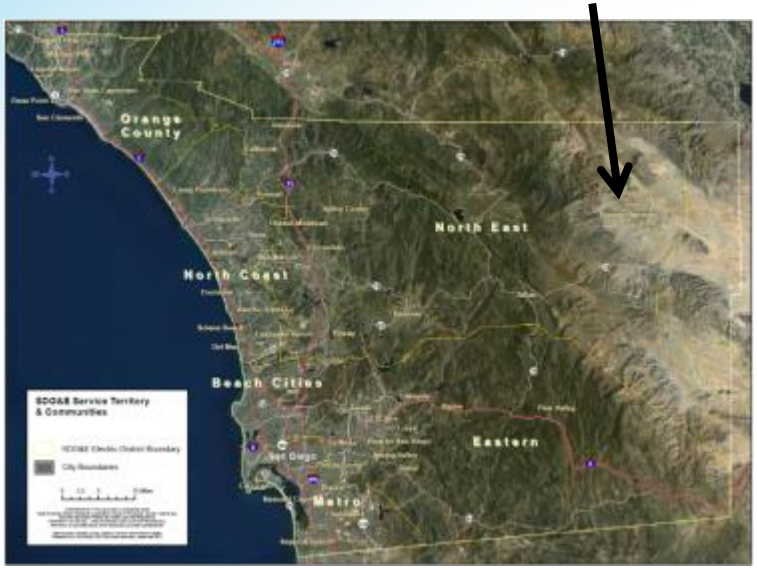
Budget:	$8.0M DOE and $2.8M CEC plus matching funds from SDG&E and partners
Benefits:	▪ Integrate and leverage various generation and storage configurations ▪ Reduce the peak load of feeders and enhance system reliability ▪ Enable customers to become more active participants in managing their energy use



Site Selection – Borrego Springs

Key Strengths:

- Progressive-minded community
- High concentration of solar generation
  - NEM (~ 1 MW)
  - Transmission (LGIA) 26 MW (2/13)
  - Distribution (WDAT) 6 MW (9/14)
- Potential for reliability enhancements
- Opportunity to balance supply and demand to be more self-sufficient
- Extendable to service territory







Utility Owned Distributed Energy Resources (DER) in Borrego Springs

Distributed Generation

- Two 1.8 MW diesel generators



Substation Energy Storage (SES)

- Energy storage that supports a substation or a significant portion of a circuit, generally 500KW – 1MW so far
- Installed:

  2 units with 1.5MW/4.5MWh capacity



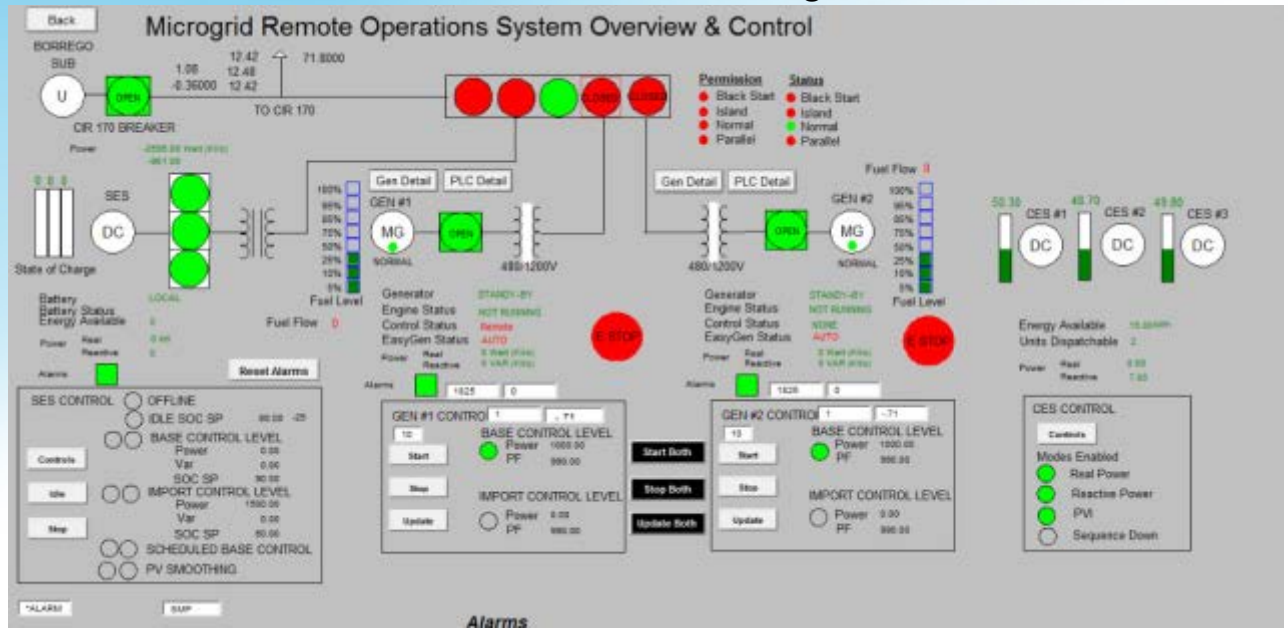
Community Energy Storage (CES)

- Energy storage that supports a small area, usually up to ~ 100kw
- Installed: 3 units with ~ 75KW/150KWh capacity



Microgrid Controls

- Provides consolidated view/control of microgrid resources





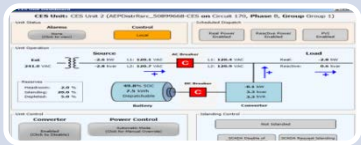
Woodward controls for generator 1



Woodward controls for generator 2



Saft SES unit

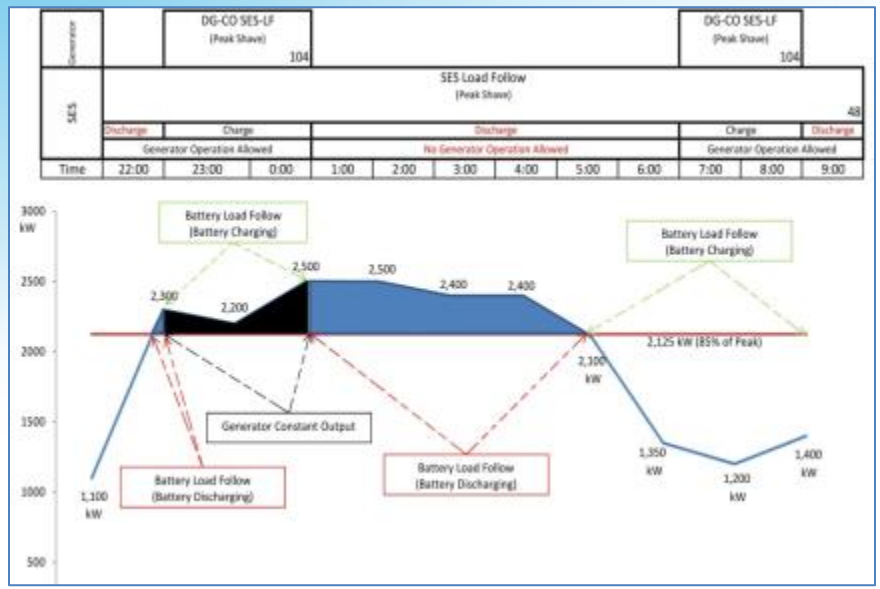


S&C CES units

Demonstrations



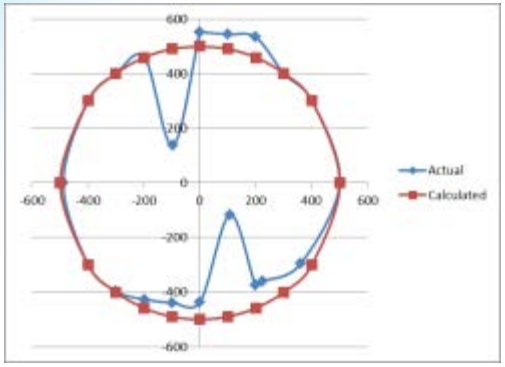
Var Control



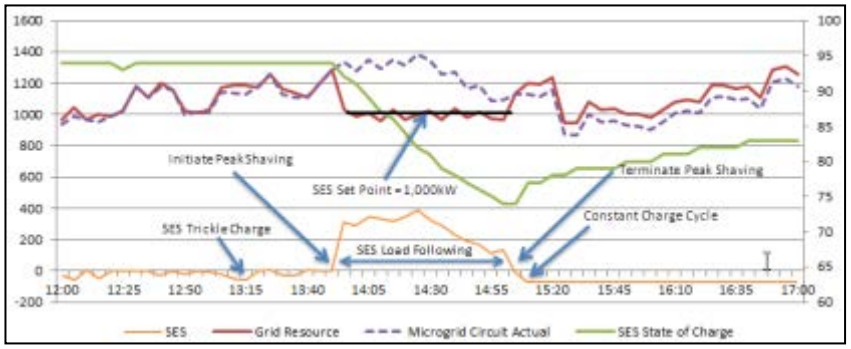
Peak Shave



"Virtual Island"



4-Quadrant Operation



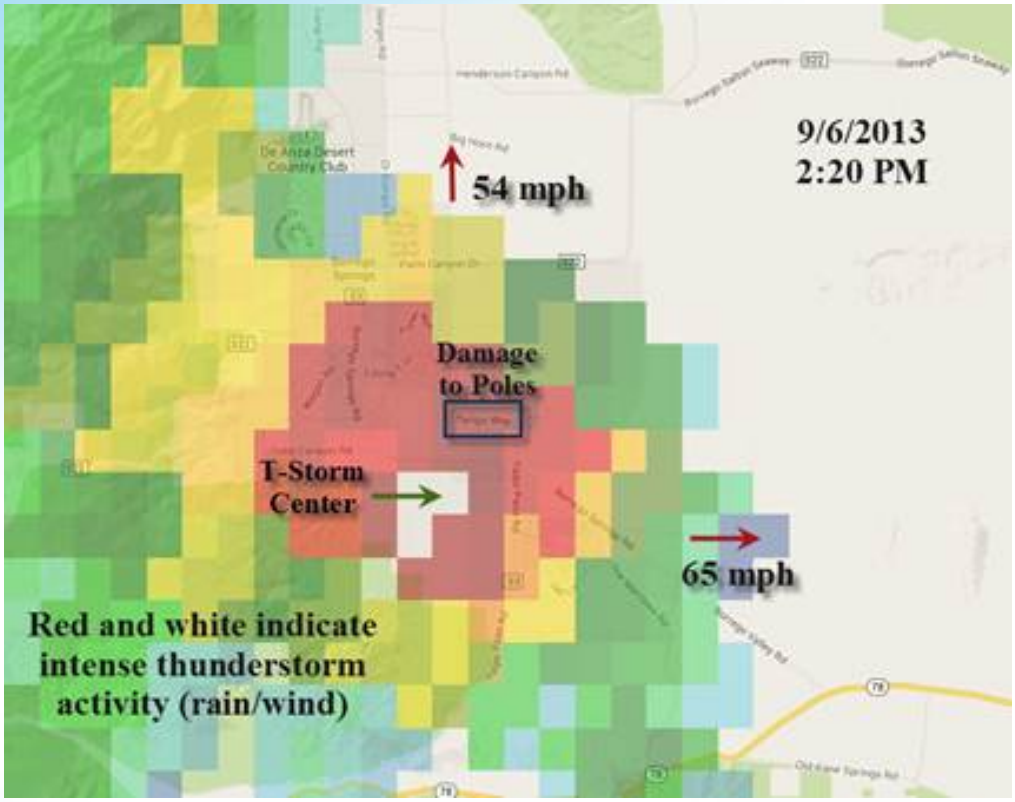
Peak Shave

Significance and Impact

Planned Outage	• June 23rd, 2012 • Microgrid provided power to 2,128 customers for ~ 5.5 hrs
Planned Islanding	• Q1 2013 • Conducted 7 islanding events over 3 days
Windstorm	• April 8th, 2013 • Microgrid provided power to 1,225 customers for ~ 6hrs
Flashflood	• August 25th, 2013 • CES units islanded six customers for ~ 5.5 hrs
Intense Thunderstorms	• September 6th, 2013 • Microgrid provided power for up to 1,056 customers for > 20 hrs

September 6, 2013

- 100 degrees by 1000 and peaked at 107 degrees at 1320
- Thunderstorms began to form between 1200 and 1300
- Produced rainfall totals of 1.3” at Warners by 1400, with similar amounts along the desert slopes west of Borrego



- Gusty outflow winds from the thunderstorms began to reach the Borrego area at 1400.
- Peak gusts of 54-65 mph were measured between 1420 and 1430, though evidence supports that a microburst likely occurred near the center of the storm, producing gusts as high as 70 mph.
- ~ 167 lightning strikes occurred in the Borrego area

September 6 – 7 Outage

- 9 transmission and 11 distribution poles were down
- All roads into/out of Borrego Springs were closed





September 6 – 7 Outage

- Restoration efforts took 25 hours
- More than 200 employees involved





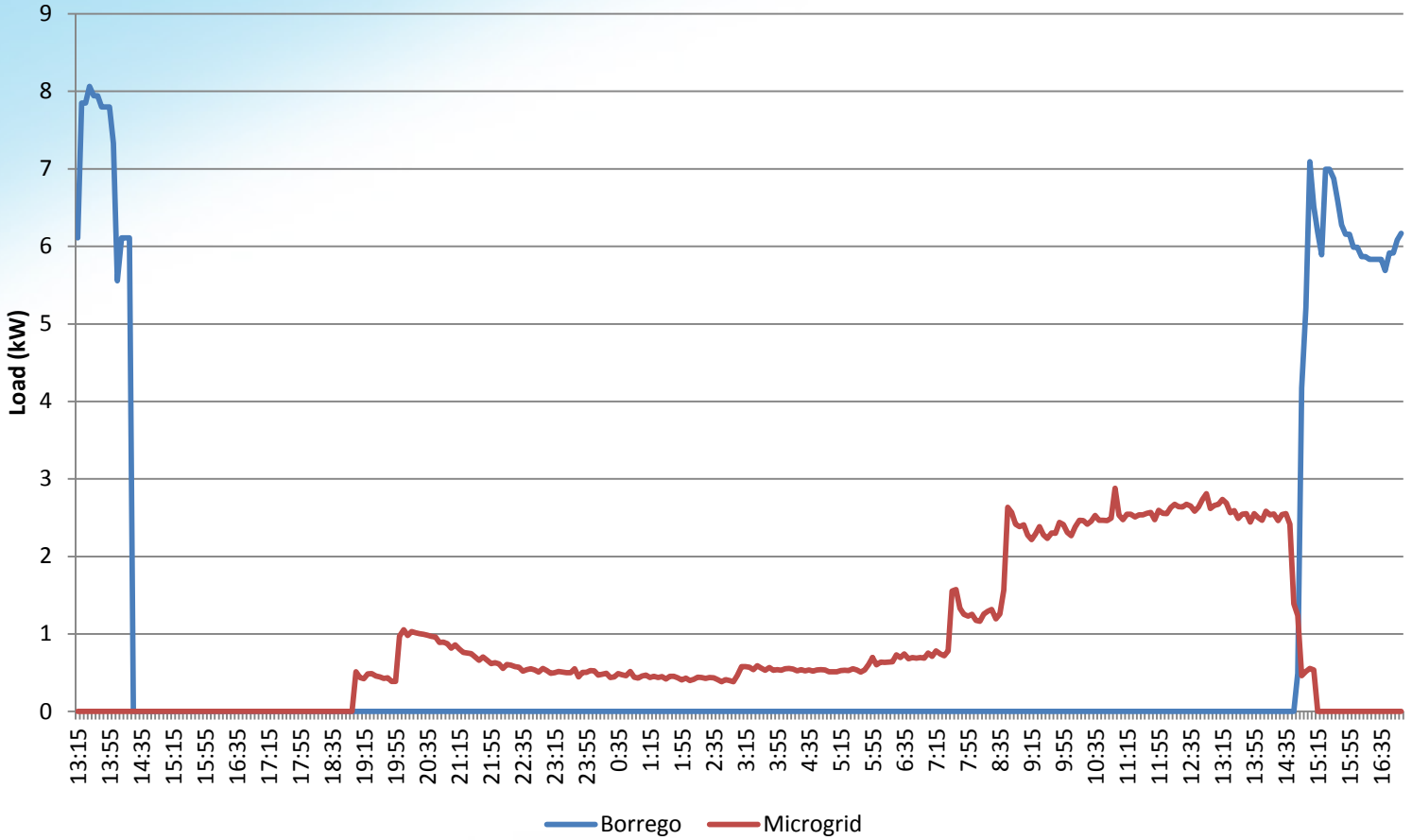


September 6 – 7 Outage



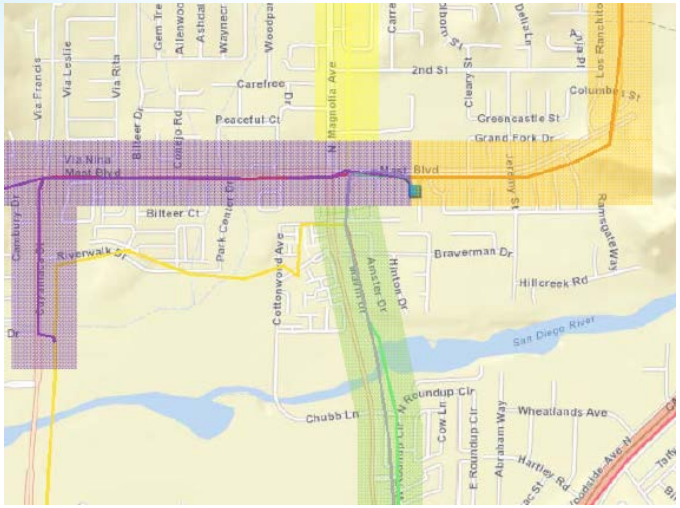
Borrego Flood Outage 9/6-7

- At 1420, single transmission line to Borrego trips out
- 9 Transmission and 11 Distribution poles reported down
- 1056 total customers restored during outage



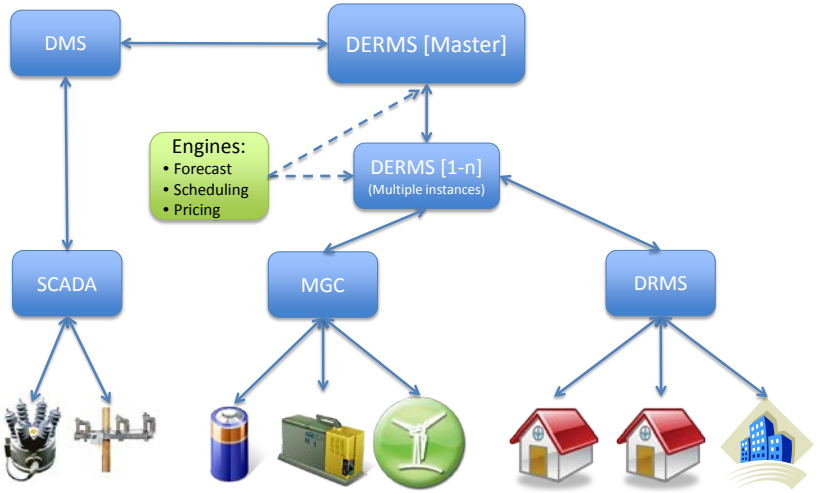
Associated Projects

- Distributed Energy Resource Management Solution (DERMS)
- Distribution Resource Plan (DRP)
- Integrated Test Facility (ITF)
- Research Development & Demonstration (RD&D)
- Energy Procurement Investment Charge (EPIC)









Borrego Microgrid 2.0 – Overview

Enhance the Borrego Springs Microgrid to be more flexible and automated in responding to a variety of potential outage situations, and leverage various new technologies and Distributed Energy Resources for increased Microgrid capabilities.

Goals

- Enhance Emergency Readiness
- Increase Operational Flexibility
- Decrease Outage Response Times
- Increase Grid Resiliency
- Demonstrate New Microgrid Technologies
- Increase Microgrid Load Capacity

Borrego Microgrid 2.0 – Local PV Integration

- Solar facilities can provide additional generation source
- Potential of islanding all of Borrego Springs during the daytime



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