Role of Microgrids in Mitigating PSPS Impacts

Agreement Number EPC-15-086

ADVANCED POWER & ENERGY PROGRAM
UNIVERSITY of CALIFORNIA · IRVINE

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Station Automation and Optimization of Distribution Circuit Operations

- **Project Goal:**
  - Establish substation control capabilities necessary to manage distribution energy assets as a single unit with
    - ✓ A high-penetration of renewable power generation, and
    - ✓ The emergence of retail/distribution electricity markets.
- **Objectives:**
  - Maximize the penetration of renewable resources and DER
  - Develop and assess the viability of a retail electricity market
  - Develop strategies for better distribution system management and use of smart grid technologies
  - Simulate and assess the deployment of fuel cells at the substation

Without infrastructure upgrades

Enable Feeder Microgrids

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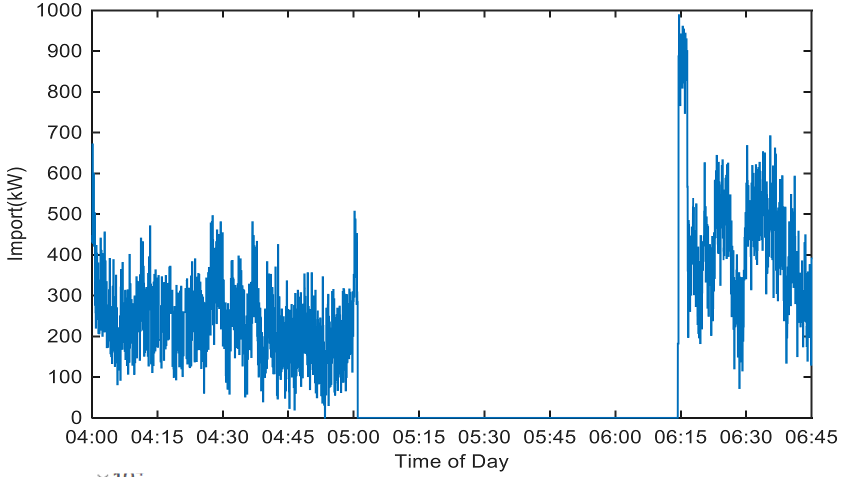
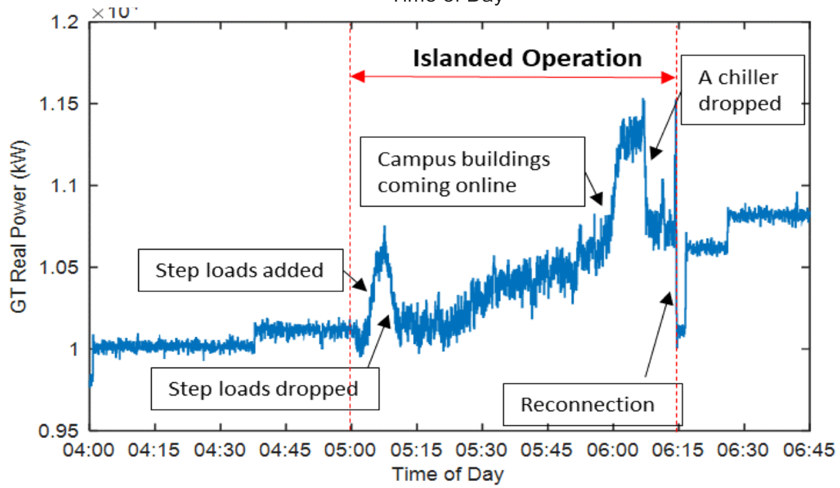
- **Approach:**
  - Model two SCE circuits
    - ✓ Validate using data from Irvine Smart Grid Demonstration Project (ISGD)
  - Simulate a controller complying with Generic Microgrid Controller (GMC) at the substation

Generic Microgrid Controller (GMC)

- **Funded by DOE**
  - October 2014-March 2018
- **Develop a GMC that provides:**
  - Seamless islanding and reconnection of the microgrid
  - Ability to provide existing and future ancillary services to the larger grid
  - Capability for the microgrid to serve the resiliency needs of participating communities
  - Increased reliability, efficiency and reduced emissions
- **Two phases:**
  - I. Research, Development, and Design
  - II. Testing, Evaluation, and Verification
    - Test, evaluate, and verify the GMC on the SCE OPAL-RT
    - Demonstrate the GMC on the UCI Microgrid

- **Results:**
  - Successful islanding demonstration
  - 33.7% reduction in GHG emissions
  - 20.22% improvement in efficiency
  - 99.23% reduction in critical load outage duration





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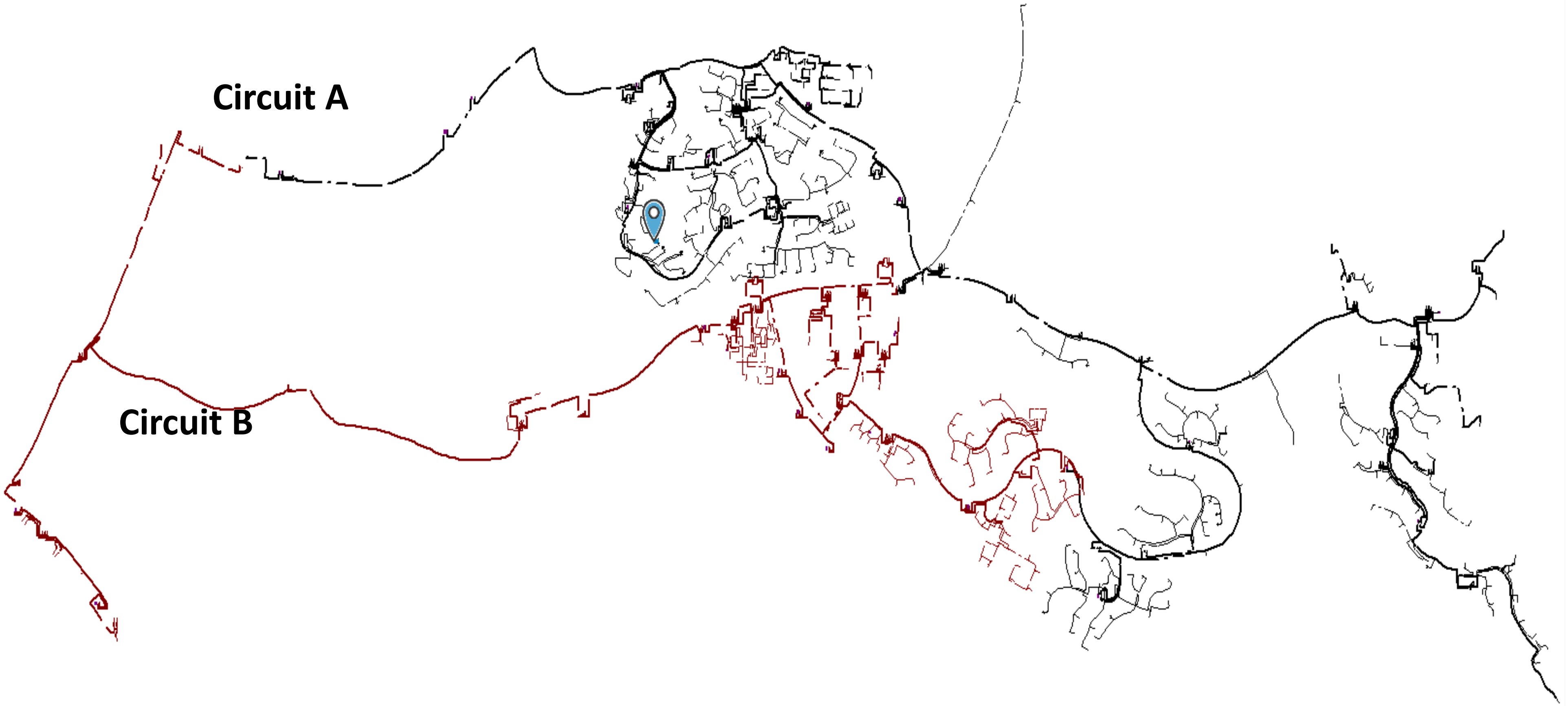

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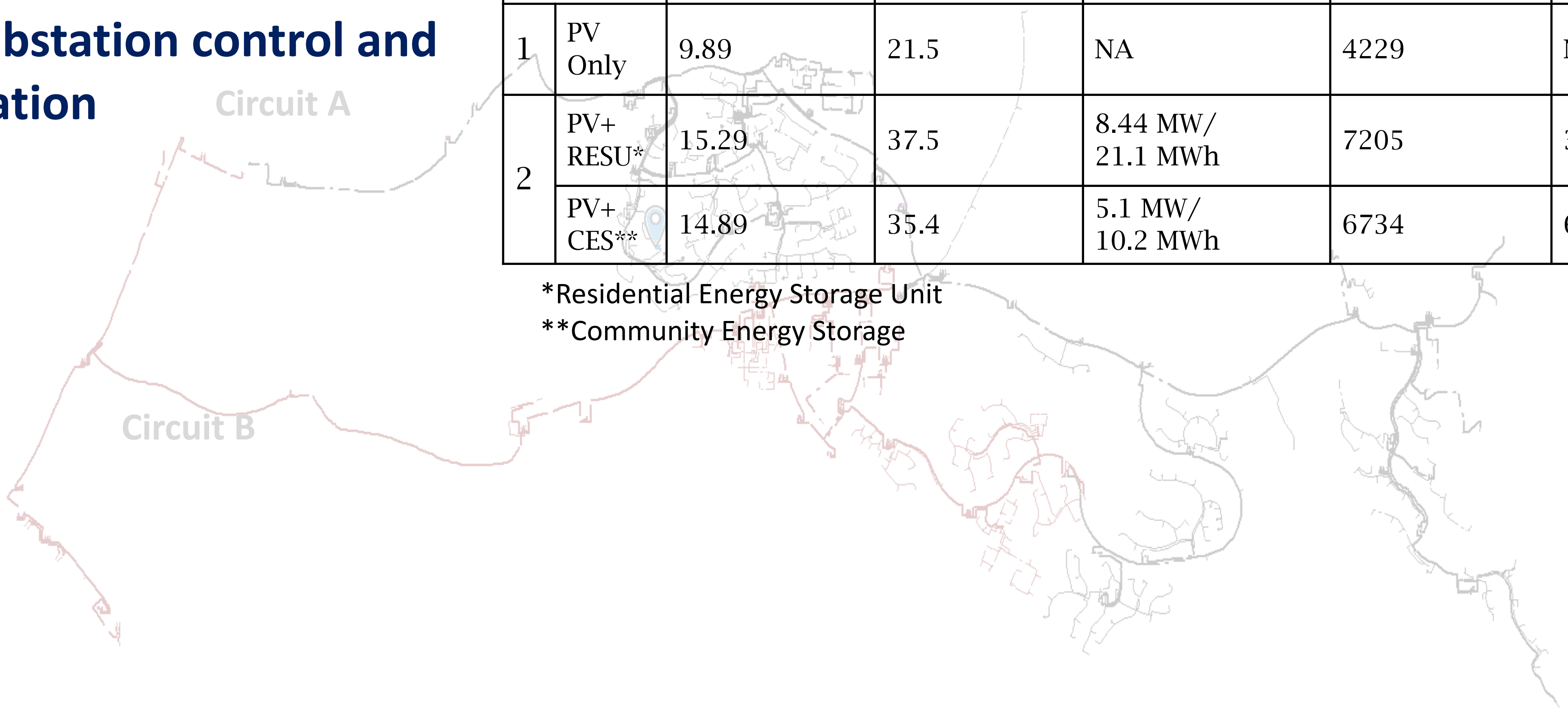
- **Higher DER (including PV) penetration can be achieved with substation control and automation**

Scenario		Total PV Capacity (MW)	PV Penetration (%)	Total Energy Storage	CO2eq Annual Reduction (mT)	CO2eq Reduction/Storage (mTon/MWh)
1	PV Only	9.89	21.5	NA	4229	NA
2	PV+ RESU*	15.29	37.5	8.44 MW/ 21.1 MWh	7205	355
	PV+ CES**	14.89	35.4	5.1 MW/ 10.2 MWh	6734	660

*Residential Energy Storage Unit
**Community Energy Storage



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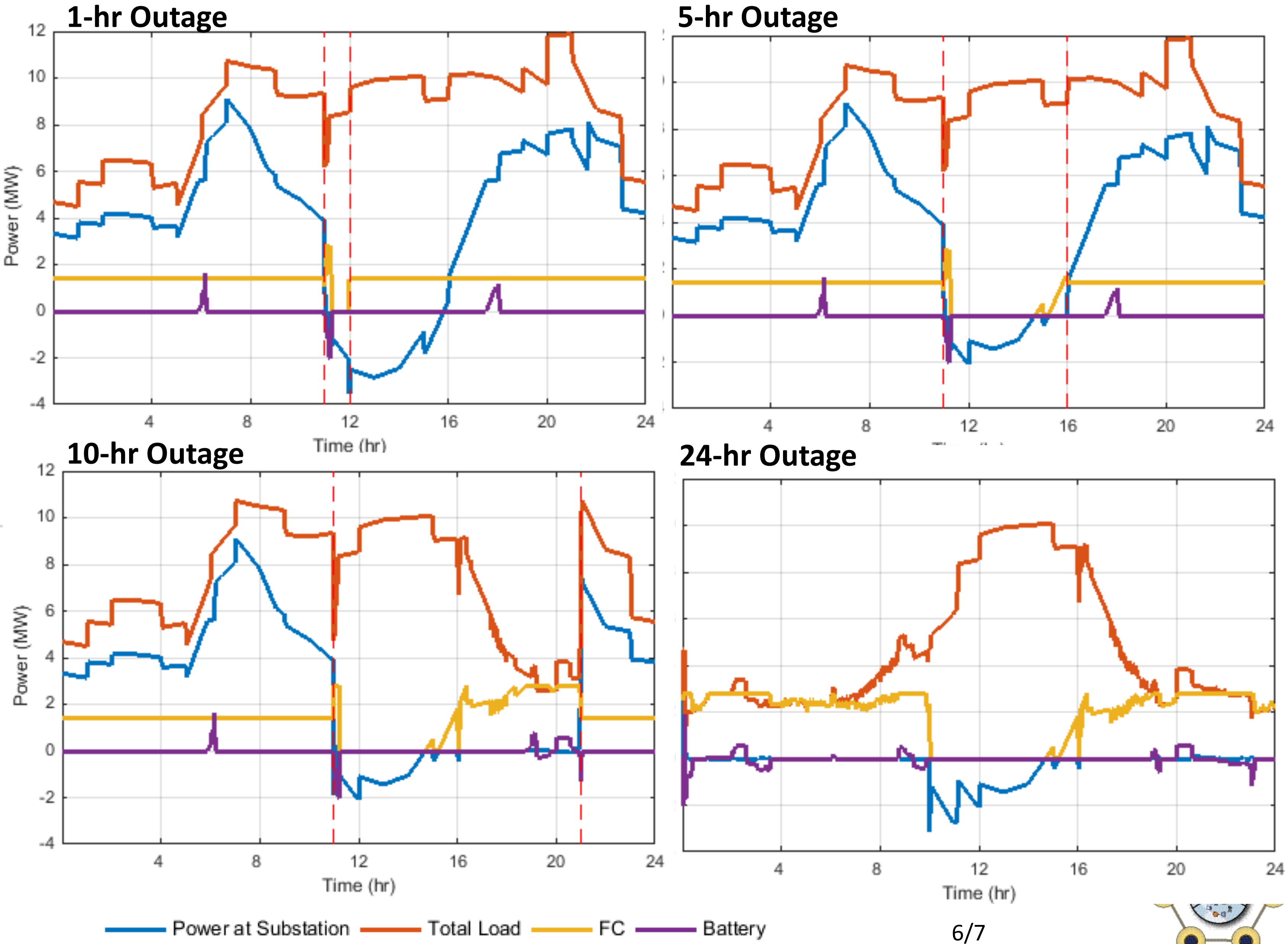
- **Higher DER (including PV) penetration can be achieved with substation control and automation**
- **Fuel cell deployment at the substation improves reliabili[ty of] the system**
  - **60% reduction in outage duration with 2.8MW fuel cell**
  - **System can form a feeder microgrid**
  - **Longer outages require load-shedding**



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- **Additional benefits**
  - Lower Costs
    - ✓ Improved efficiency (5%): 13TWh/year (CA)
    - ✓ Avoided transmission losses: 15.5TWh/year (CA)
    - ✓ Avoided outage costs:$67-$82M (SCE customers)
  - Other Benefits
    - ✓ Reduced fossil fuel: 2.5E11 BTU of NG/year
    - ✓ Reduced demand
    - ✓ Increased safety
    - ✓ Energy security
    - ✓ Enhanced resiliency
    - ✓ Reduced RPS procurement
    - ✓ Avoided upgrade costs

- **Follow-on project**
  - Funded under SB 1
    - ✓ Institute of Transportation Studies
  - Use of PEVs in vehicle to home (V2G)
    - ✓ Residential nanogrid
    - ✓ Reducing up to 250 lb of NOx per day compared to backup generators
    - ✓ Reducing outage duration by at least 50%
  - Use of DERs and PEVs in:
    - ✓ Grid restoration and blackstart of utility assets
    - ✓ Serving critical loads during outages
    - ✓ Reducing 300 lb of NOx per event compared to backup diesel generator

Disclaimer

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