Lessons Learned in Successful Microgrid Controls and Protection

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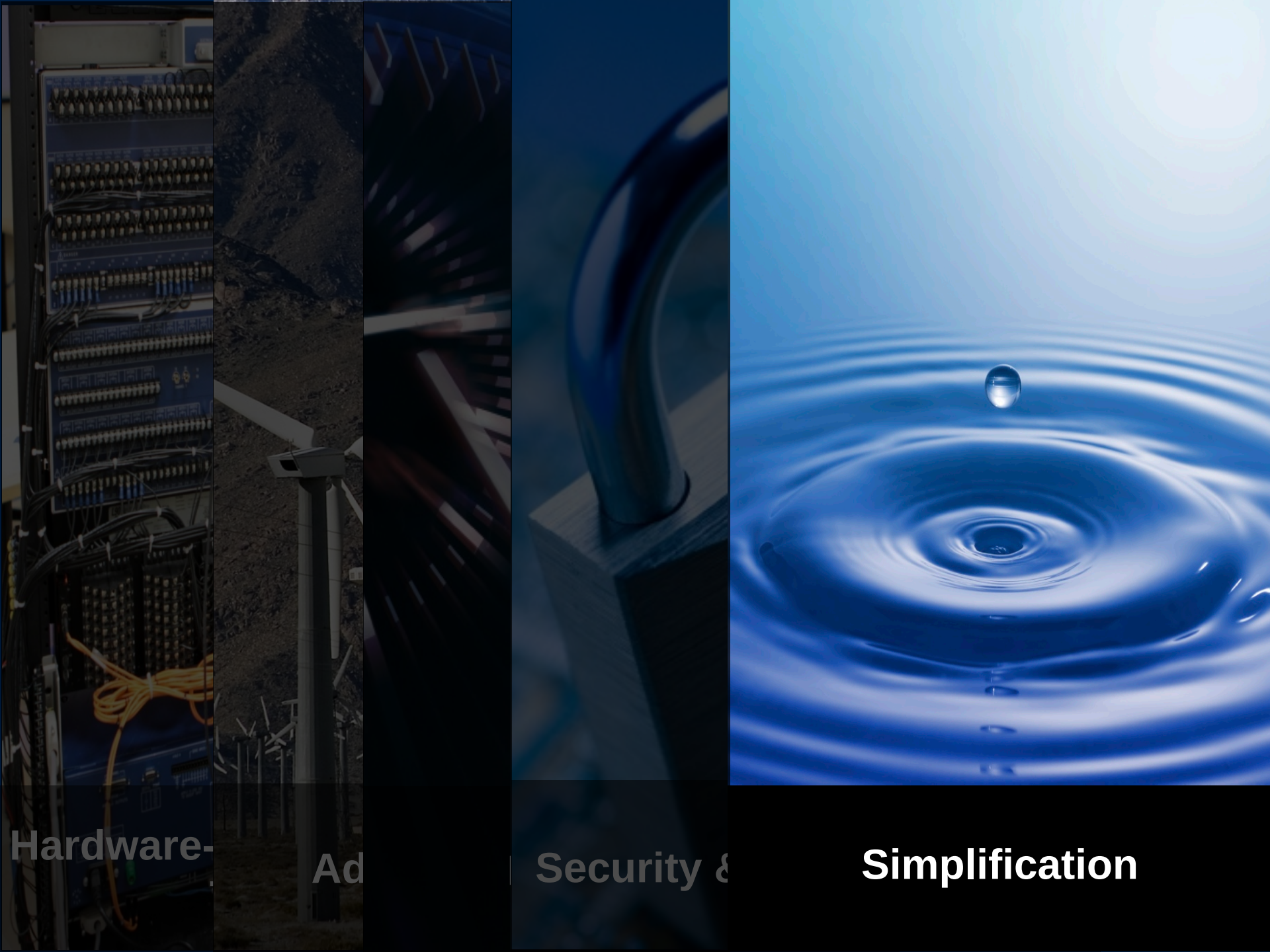

Hardware-
Ad
Security &
Simplification

Partnership With Research

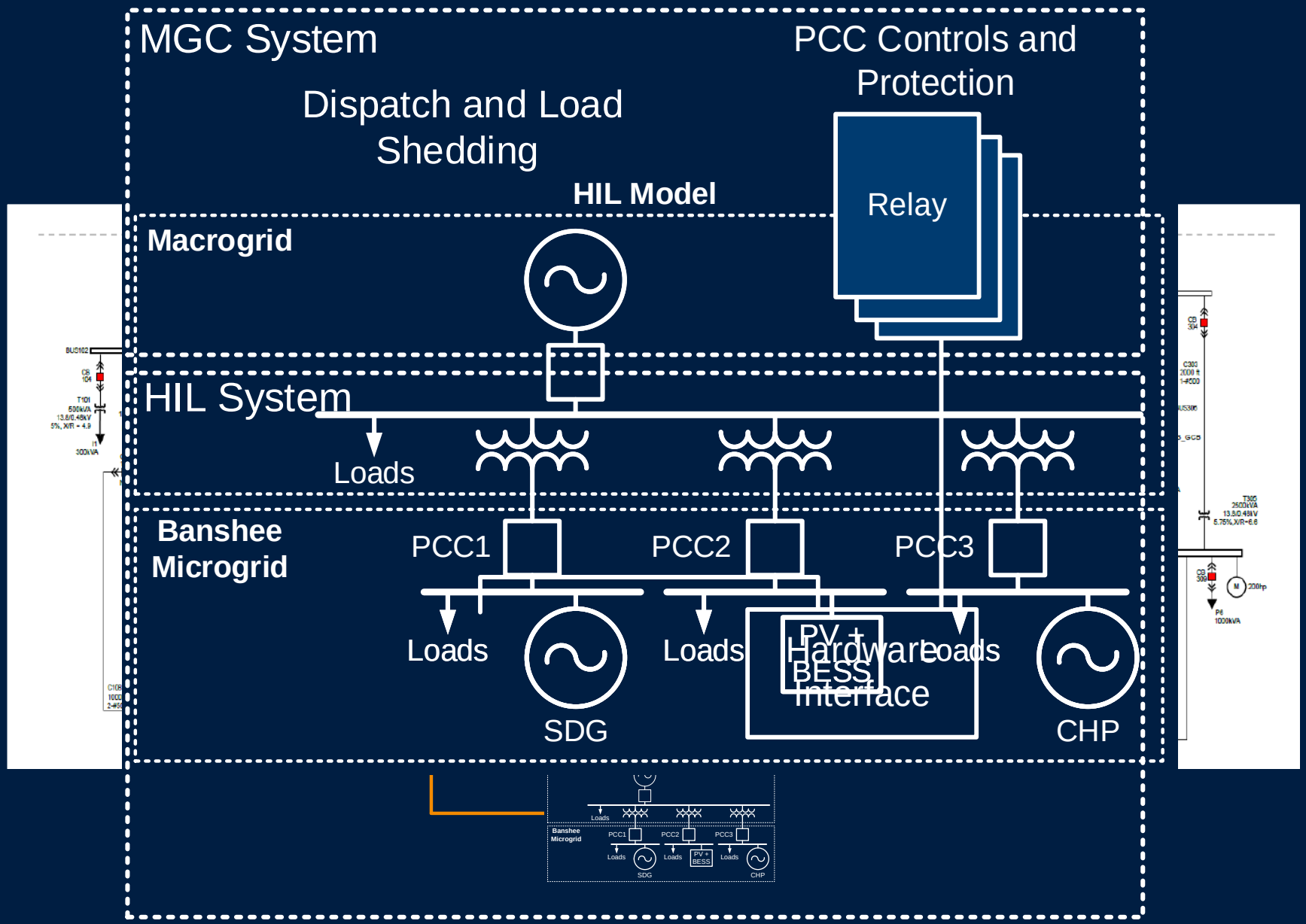
MIT Lincoln Labs Microgrid & DER Controller Symposium

Contribution at MIT Lincoln Laboratories

- Microgrid controller
  - Factory acceptance tests (FATs)
- High-speed interface electronics
  - Integration support for MIT Lincoln Laboratories HIL simulator
- Feeder protection relays and programming
- Banshee model ported to real-time digital simulator (RTDS)
- HIL device validation for microgrid controller

HIL Testing Setup

Power Systems Testing Lab



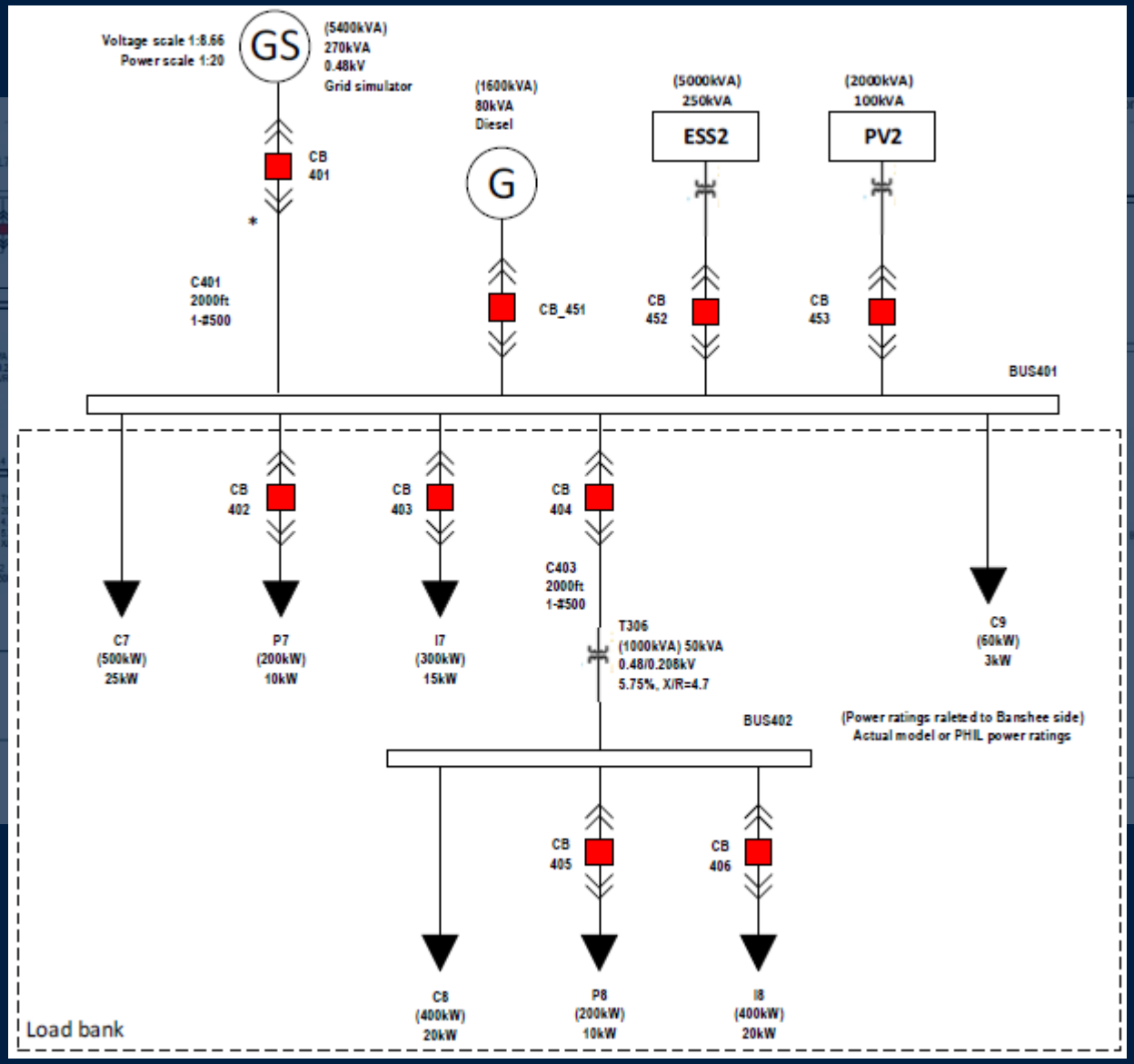
Partnership With Research

National Renewable Energy Laboratories (NREL)

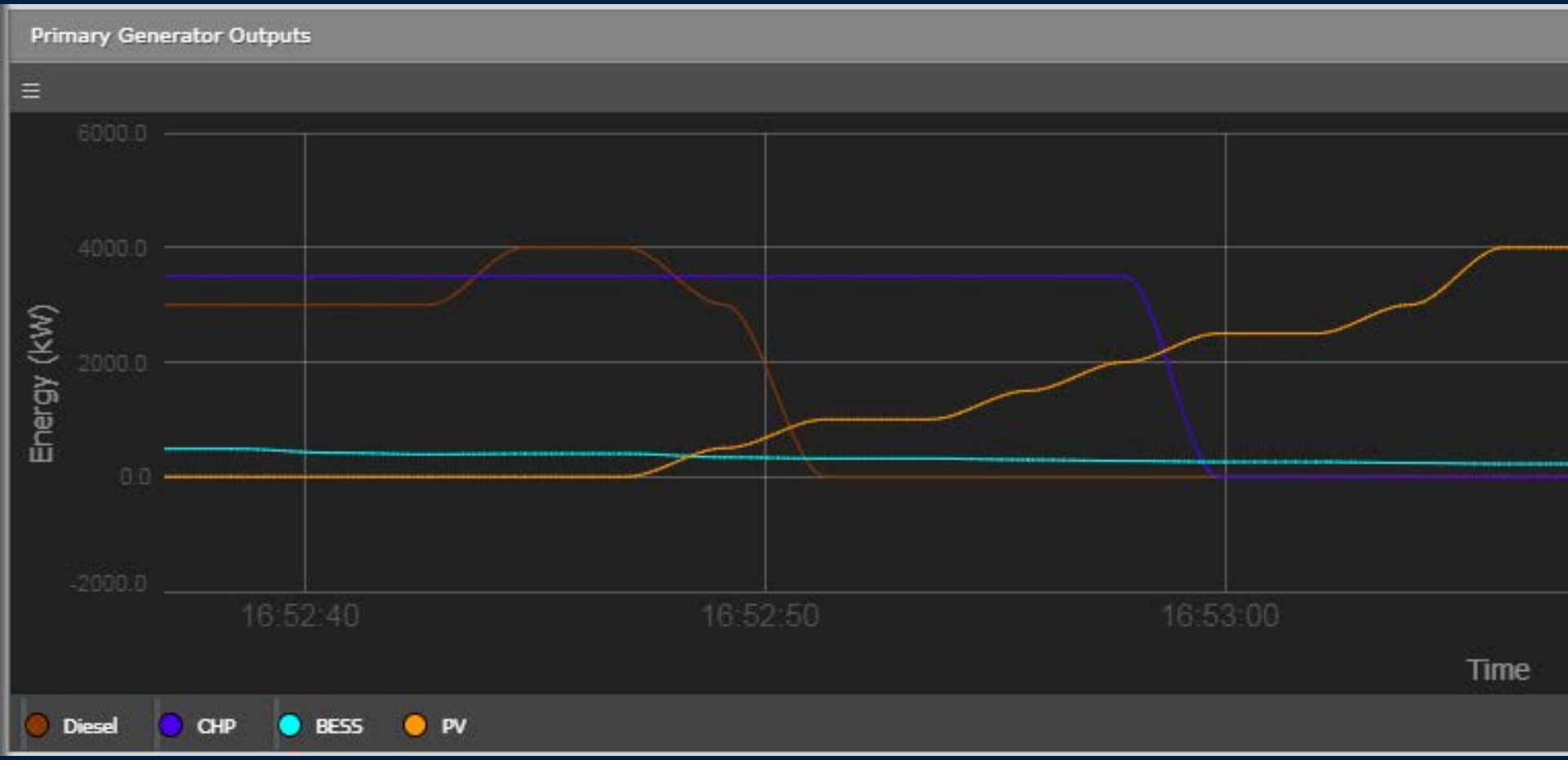
Contribution at NREL

- Power HIL device validation
- Cyber-physical test bed
- Economic optimization
- Adaptive protection
- Key Performance Parameter (KPP) evaluation

Power Systems Testing Lab



Economic Dispatch
Microgrid Cost Factors

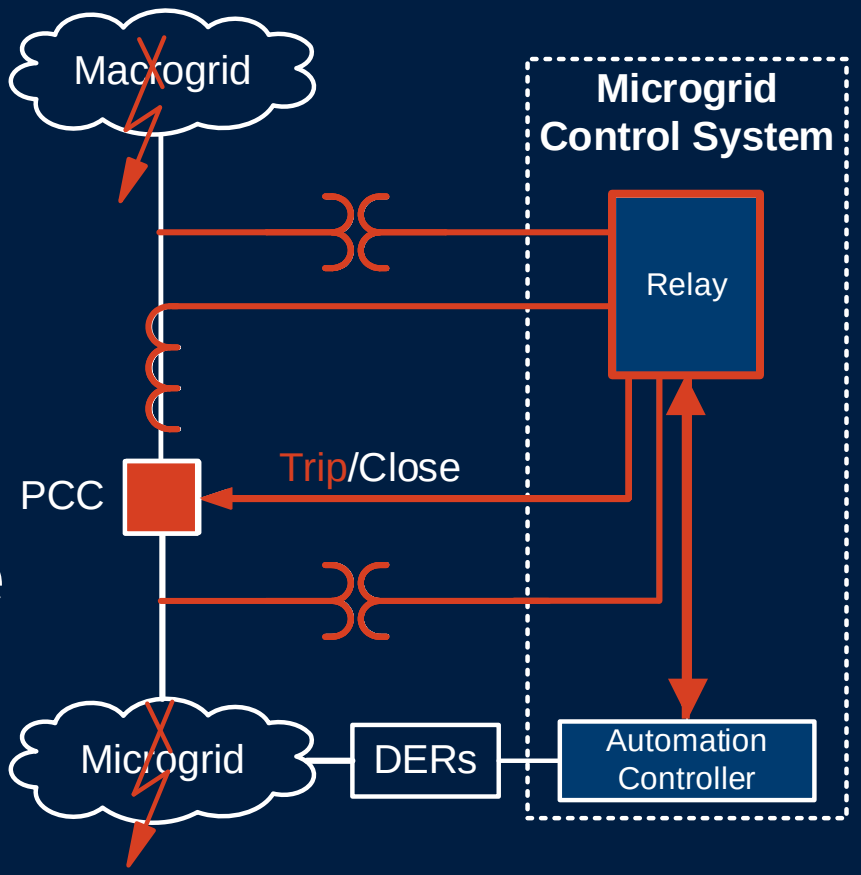


Fundamental Component

Protective Relaying

Protective Relay at PCC
Provides ~50% of Control Functionality

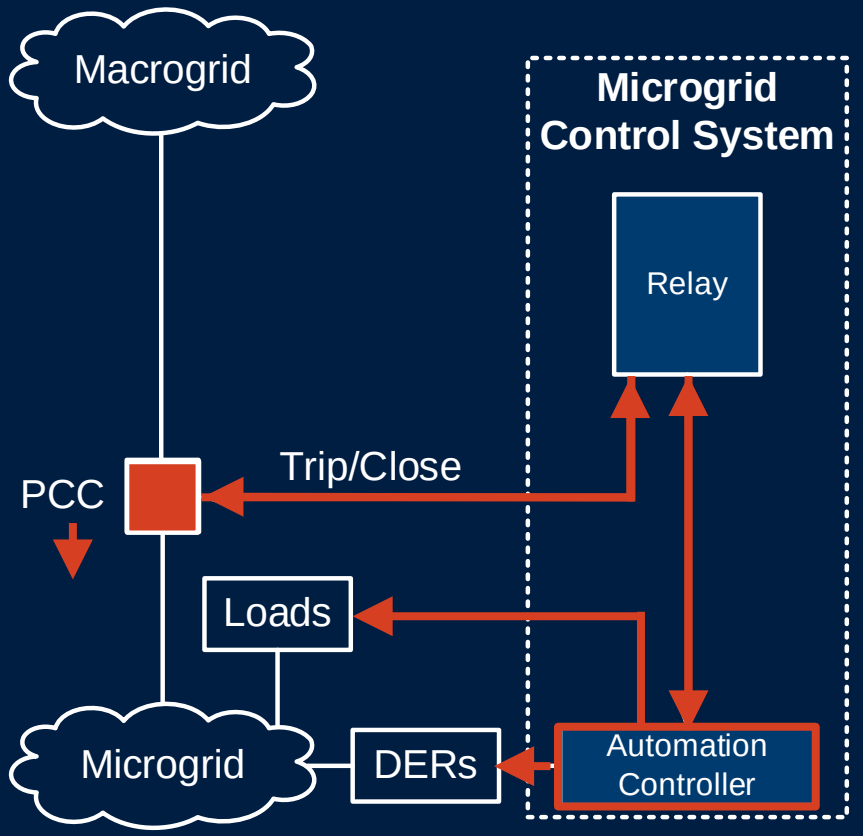
- Grid reconnection
- Unintentional islanding
- Protection for expensive assets
- IEEE 1547 compliance
- Metering
- Pass-through control



Microgrid Controller

Load Shedding, Dispatch, and Islanded Regulation

- Load shedding
- Intentional islanding
- PCC dispatch
- Power factor (PF) control
- Voltage regulation
- Frequency regulation
- Economic dispatch




Questions?