INTERNATIONAL DISTRICT ENERGY ASSOCIATION

Welcome to the IDEA Webinar Series

- The webinar will **start promptly at 2:00pm EDT (Boston time) and is scheduled to last one (1) hour.**
- Please **mute your phone** during the webinar. All lines are muted.
- If you are having problems with video or audio, please send a note via the Chat Box function on the right side. Click the Chat box and choose – **"Chat privately to Cheryl Jacques (host)". Or call to IDEA at 508-366-9339.**
- **Questions to Presenters**: Please enter your **Questions** in the **Q&A** box at the lower right of the screen. These questions will be moderated and addressed as time allows. We plan to handle Q&A at the conclusion of the presentation.
- **Survey**: Please complete the brief on-line survey following the webinar.
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A Practical Overview of Microgrids

Mike Dempsey, P.E.

Eric Putnam, P.E.

Definition

*The **U.S. Department of Energy**'s official definition of a microgrid is "a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid [and can] connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode."*

Definition

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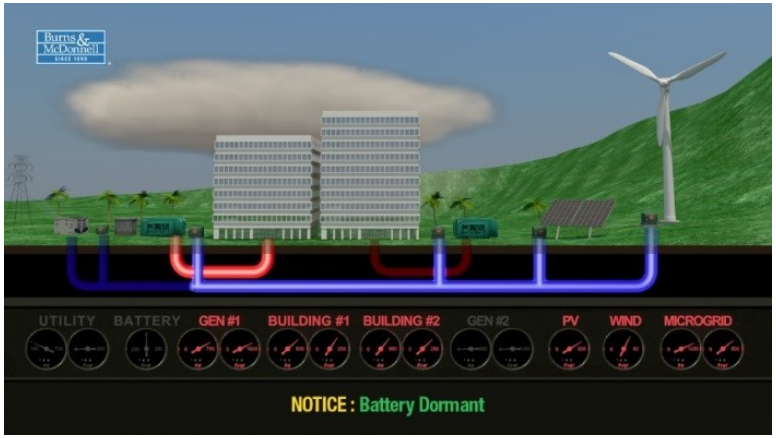
Common Features

- Decoupling of Generators from Loads
- Seamless Transitions to/from Utility
- Increased Redundancy of Generation

Common Benefits

- Increased Situational Awareness for Operators
- Integration of Renewable Resources
- Multiple Modes of Operation Both Islanded and Grid-Tied



What Microgrids are Not

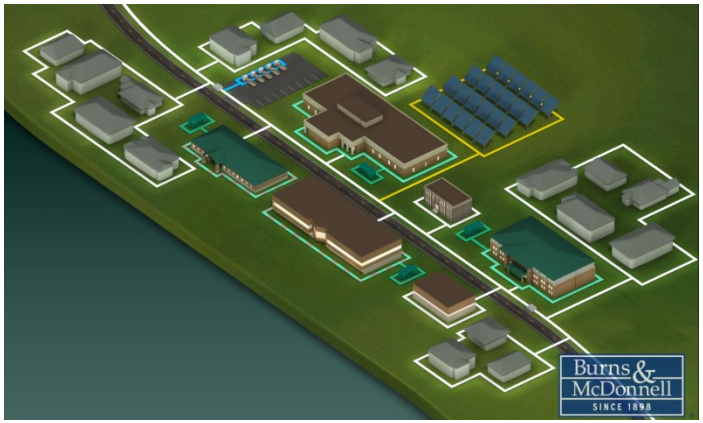
- Uninterruptible Power Supplies (UPS)
- Controls-Only Solutions
- One Size Fits All

Assessment Process

- Identify All Sources of Power
- Identify All Loads to be Served
- Determine Criticality of Each Load and Capabilities of Each Resource
- Utility Interconnection Requirements

Distribution System

- Identify Point(s) of Common Coupling with Utility
- Determine if Seamless Transition is Required
- Evaluate which Components of System Must be Dynamic



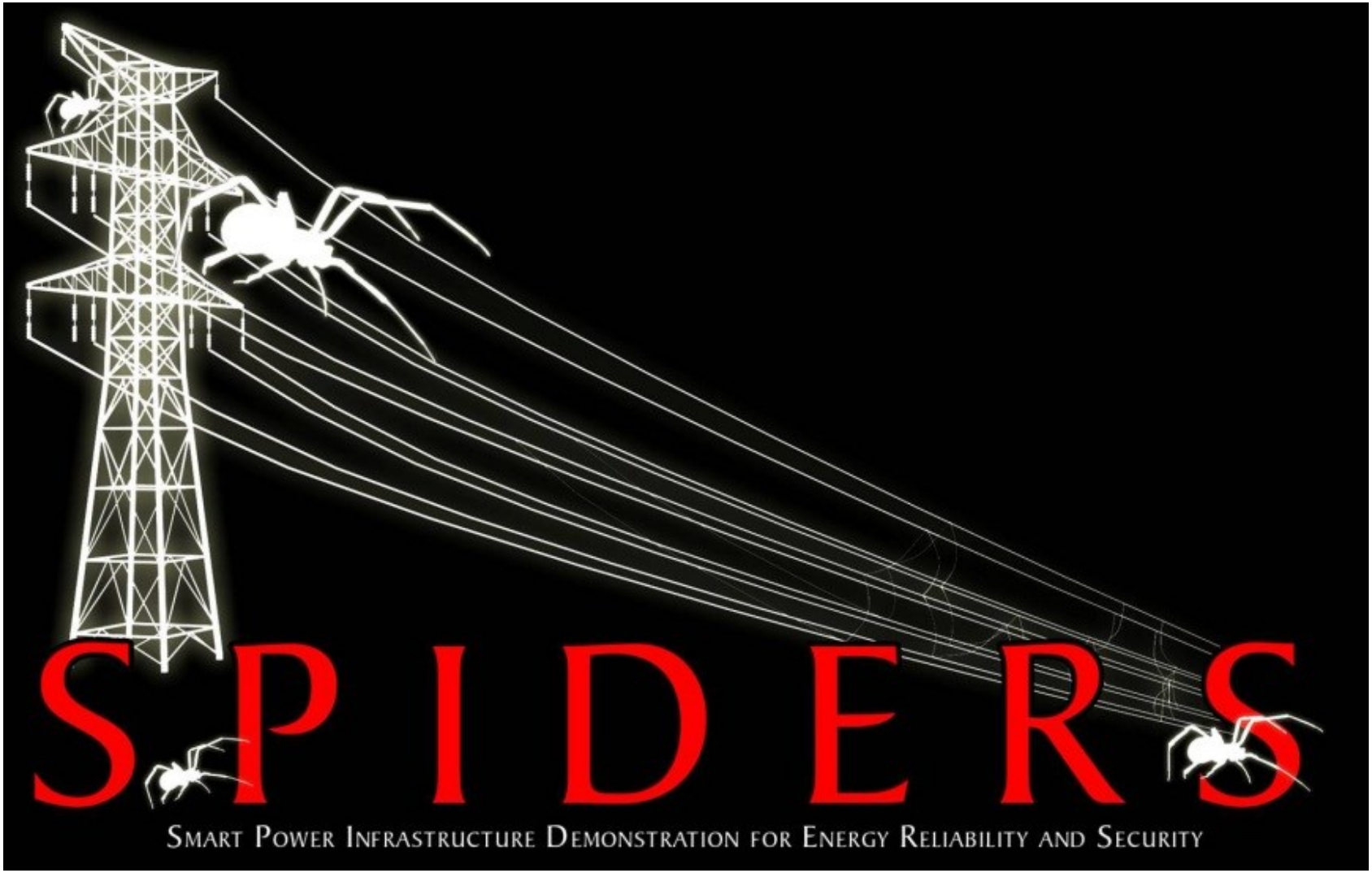
Control System

- Evaluate Existing Control System's Capabilities
- Determine New Control and Data Points
- Determine Cyber Security Risks

Case Studies

- SPIDERS
- GRU & U of Florida Shands Hospital
- TECO
- AE Dell Children's Hospital
- UT Southwestern Medical Center
- U of Iowa

Burns & McDonnell
SINCE 1898
®



Purpose of SPIDERS

REDUCE DIESEL FUEL CONSUMPTION

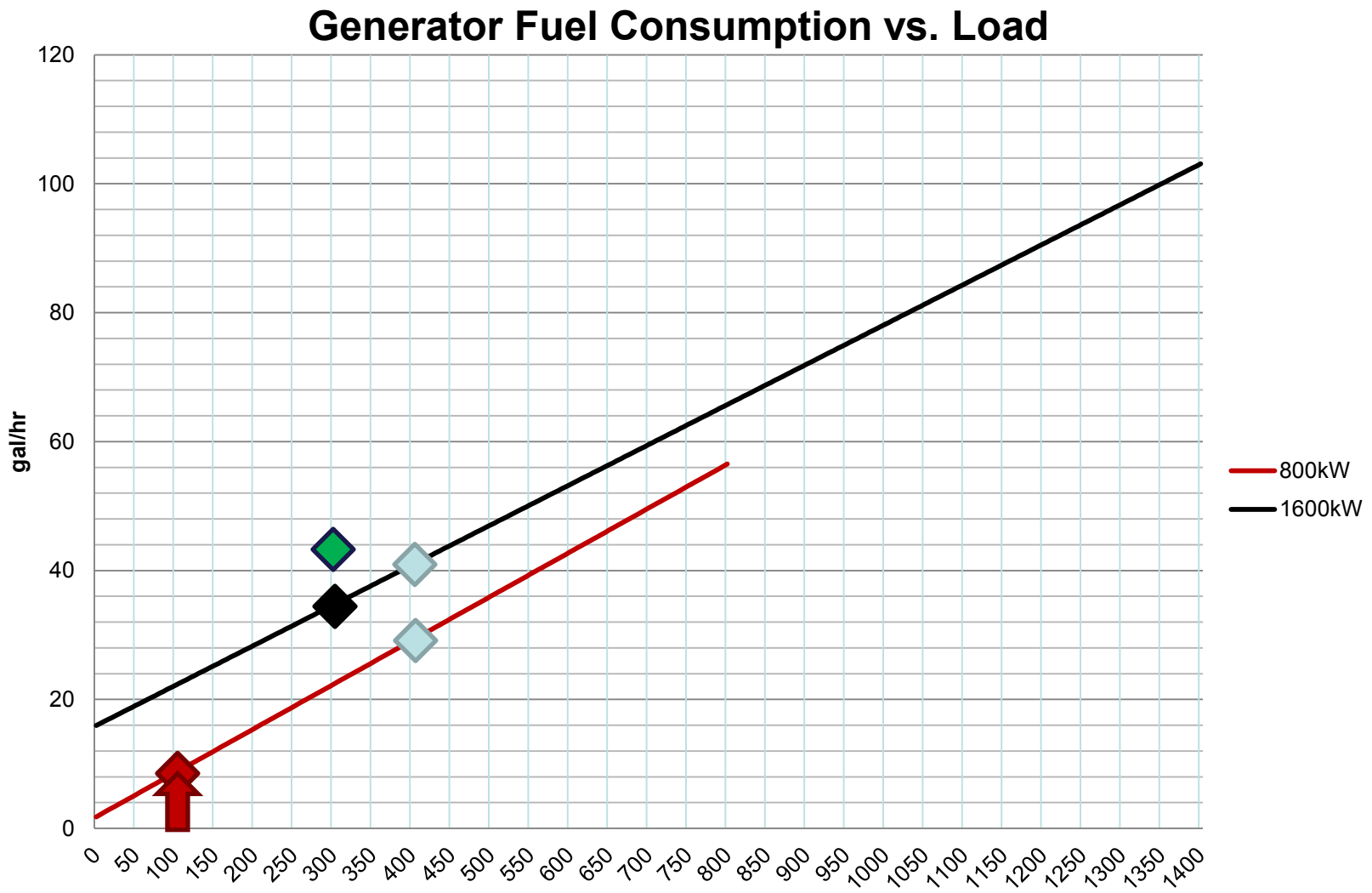
&

INCREASE RELIABILITY

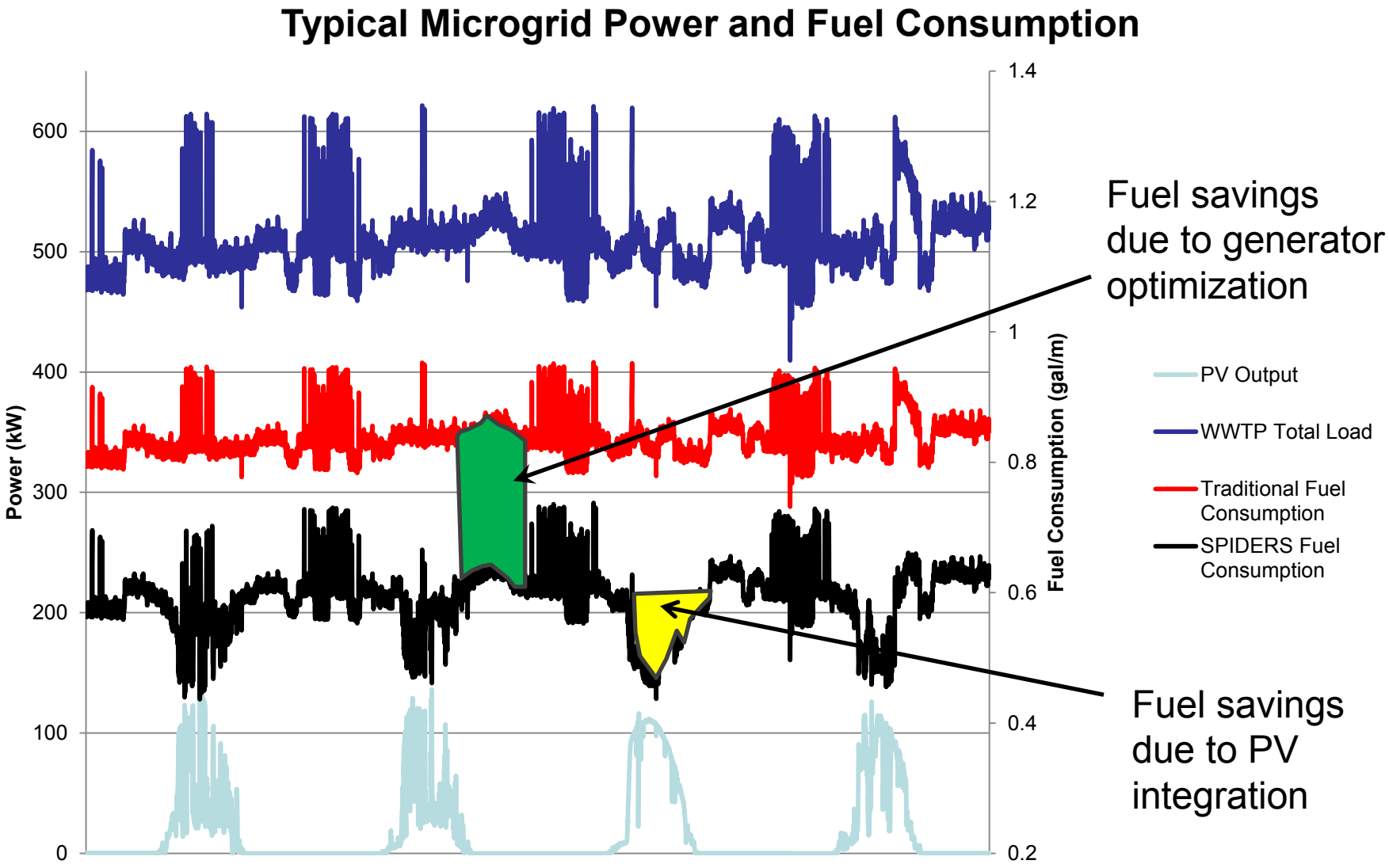
Distributed Approach

- Any Power Source Can be a SPIDERS Generator
- Controls are Distributed to Match Generators and Loads
- Dynamic Electrical Topology Responds to System Events

Generator Optimization



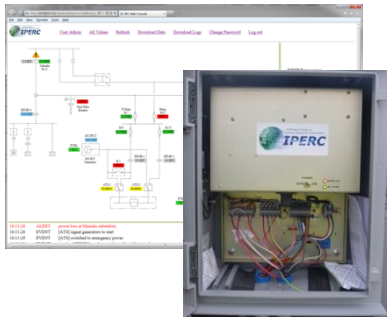
Phase I Performance



SPIDERS Phase I

Phase I Components

DoD Owned Substation



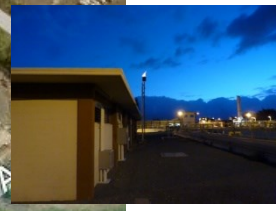
Distributed Microgrid Control System

15kV Feeder

1600kW Generator

Renewable Island

800kW Generator



Critical WWTP Loads

SPIDERS Phase II

SPIDERS Phase II

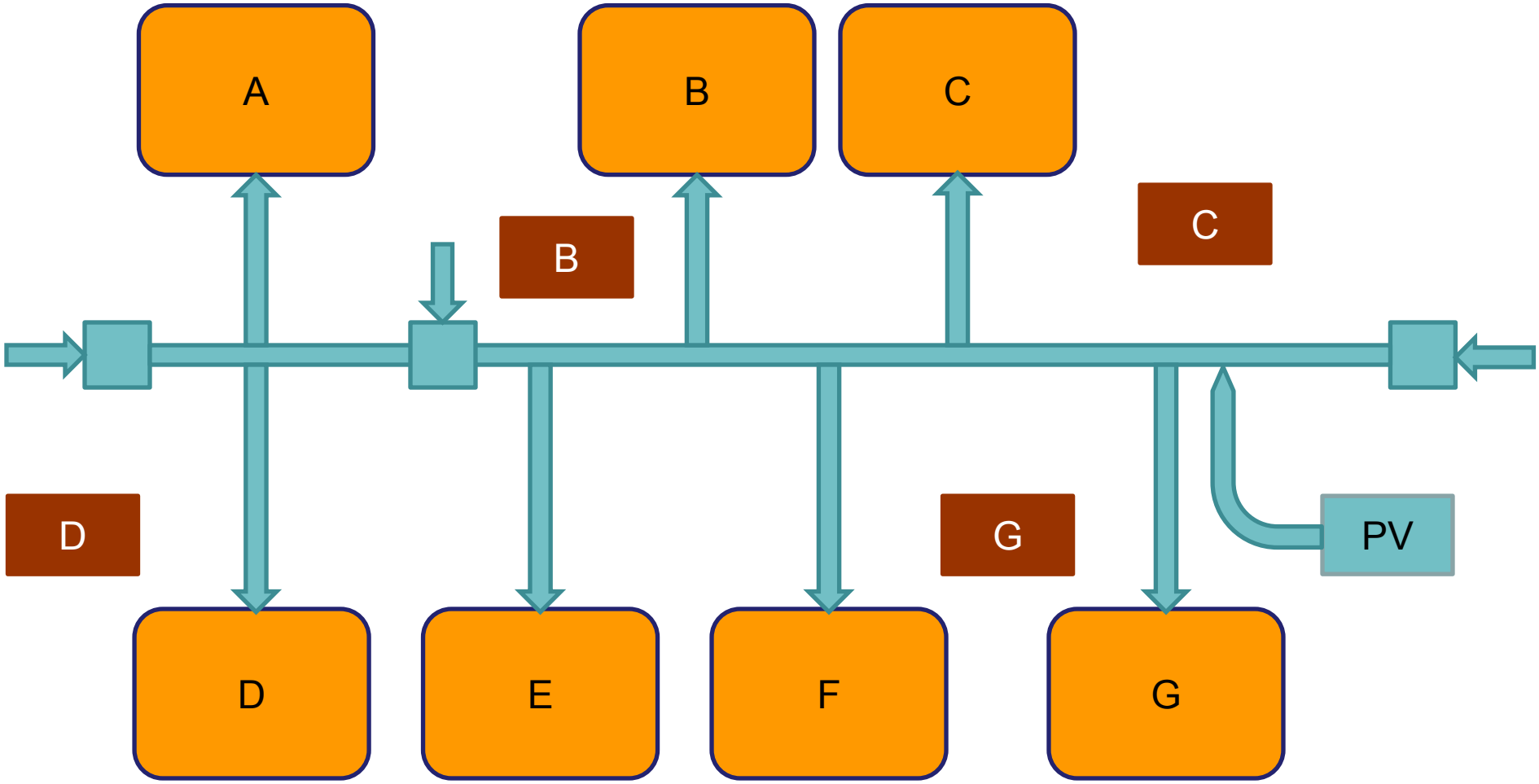
- Three Microgrid Diesel Generators (3MW total)
- 1MW PV Array
- Five Bi-Directional Hi-Speed Electric Vehicle Charging Stations (300kW / 400kWh total)

EV Charging Stations

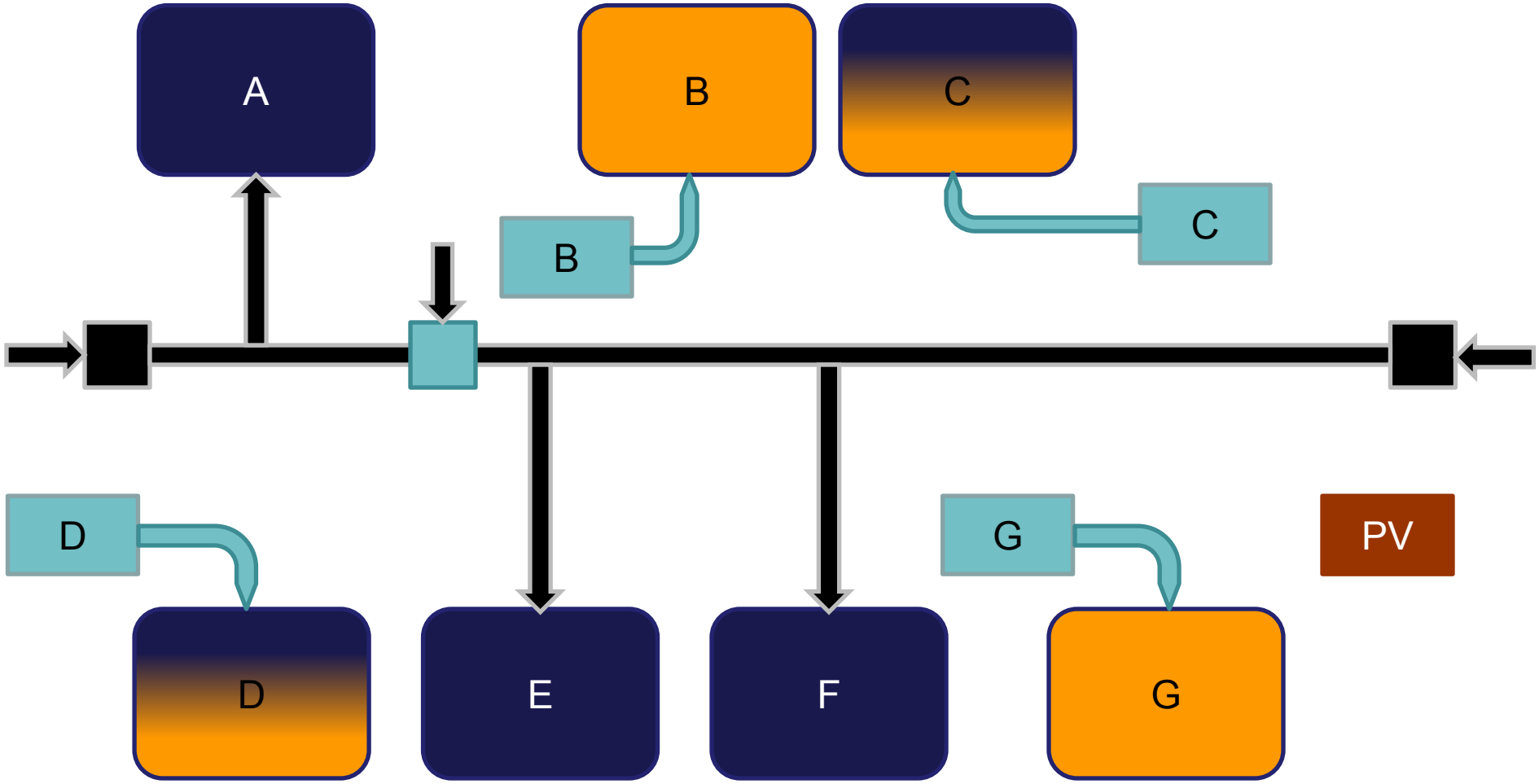
- Five, 100kVA Stations
- Four Quadrant Control Permits VAR Support of Utility or Microgrid Even Without Vehicles
- Aggregator Allows Smart Charging of Fleet Based on Utility and Functional Requirements

Phase II Microgrid

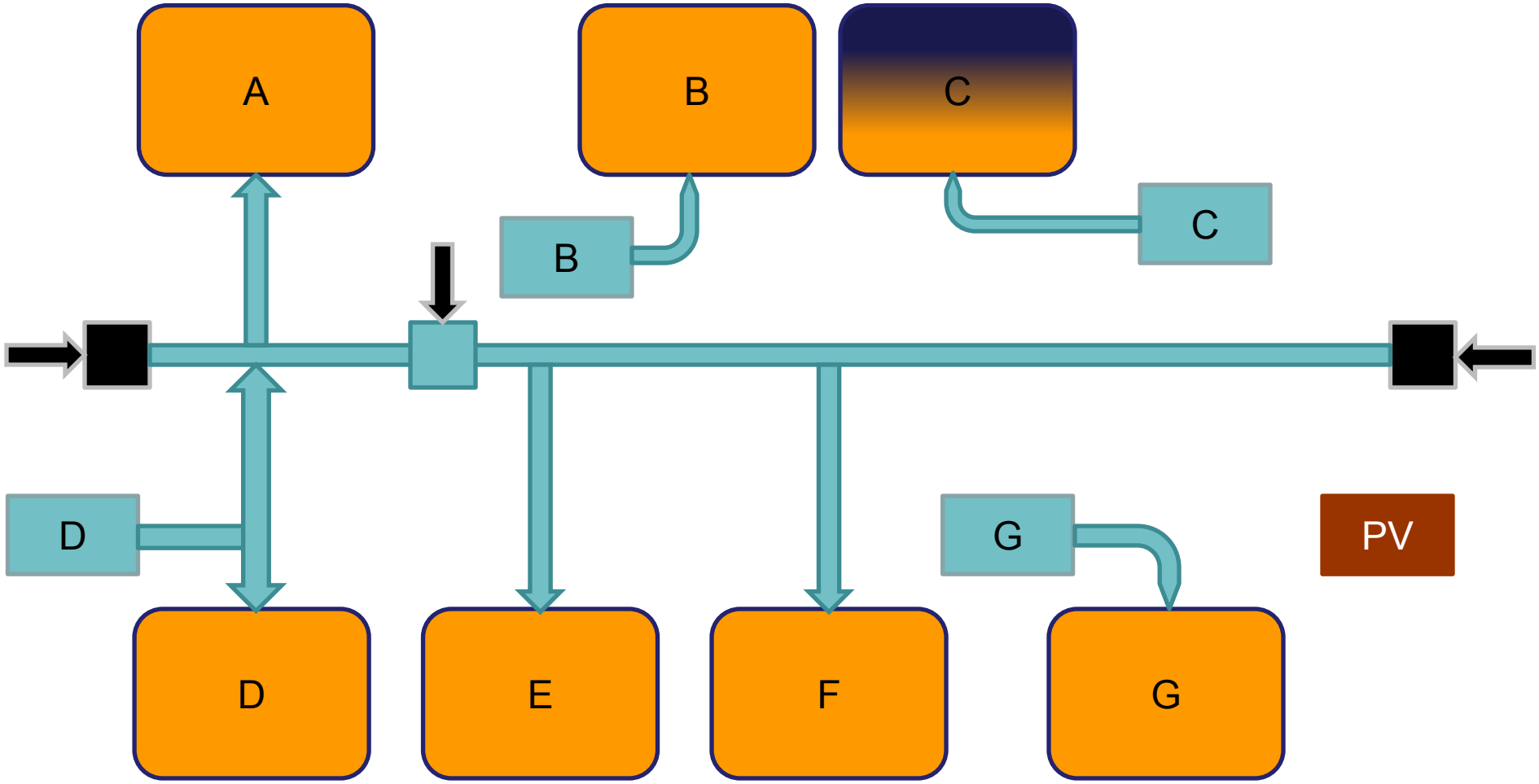
Normal Operation



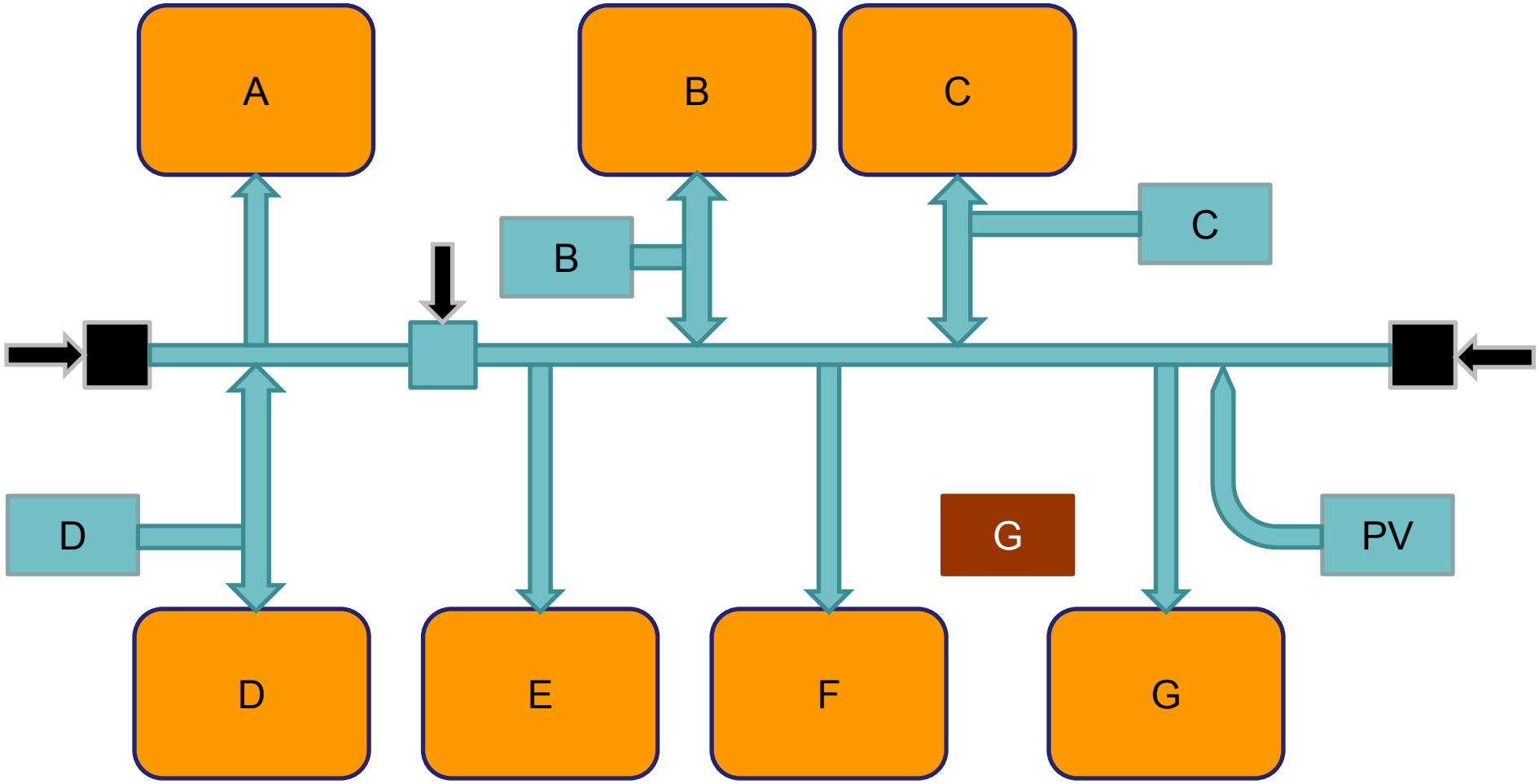
Utility Failure



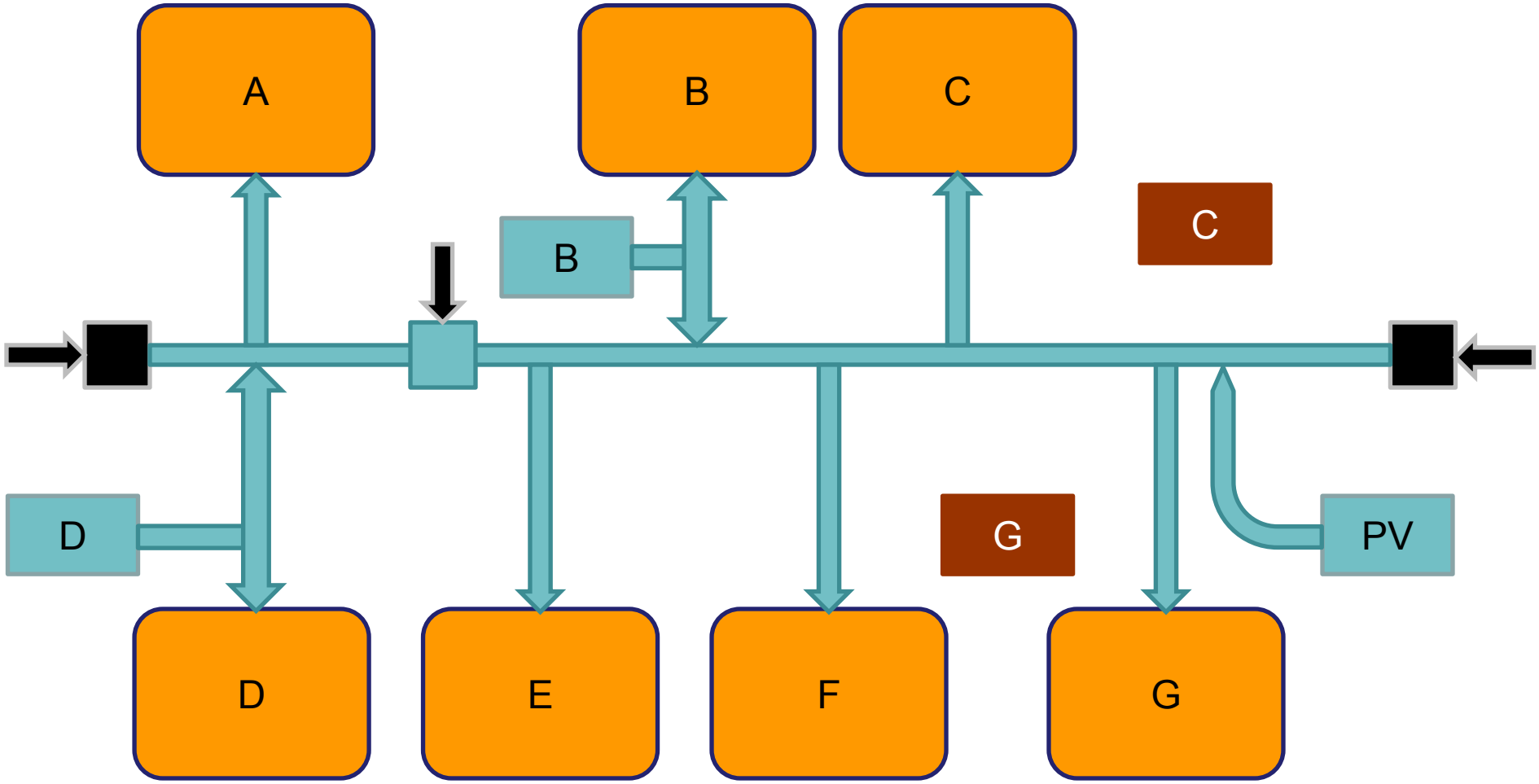
Microgrid Forms



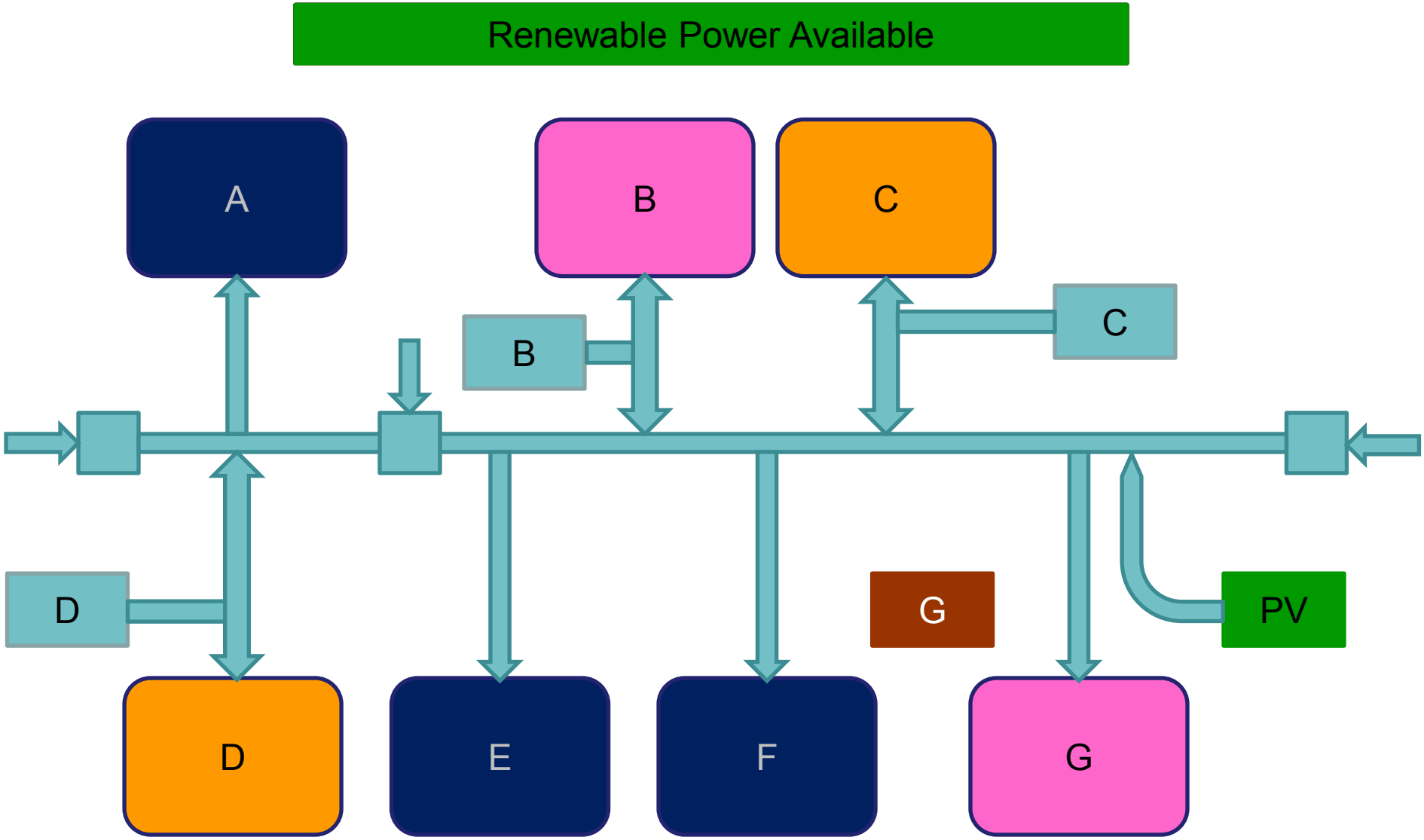
Microgrid Fully Formed



Generator Optimization



Microgrid Differences



SPIDERS Phase III

SPIDERS Phase III

- Microgrid to Support Entire Military Base
- EPA Tier 4i Generators Permit Economic Dispatch for Utility Ancillary Services
- Battery Storage for Blinkless Transfer to Microgrid for Critical Buildings on Utility Loss
- Distributed Solar Power

SPIDERS Successes

- Cyber-Secure Controls
- Stable Operation of Microgrid with 90% PV Penetration
- Bi-Directional Charging of Electric Vehicles in Grid-Tied and Islanded Operation
- Optimization of Distributed Generation
- Increased Reliability

Gainesville Regional Utilities &
UF Shands Cancer Hospital

Overall Project

- New Medical Campus Focused on Treatment of Cancer
- Multiphase Construction
- Energy Services Outsourced as Design / Build / Own / Operate / Maintain

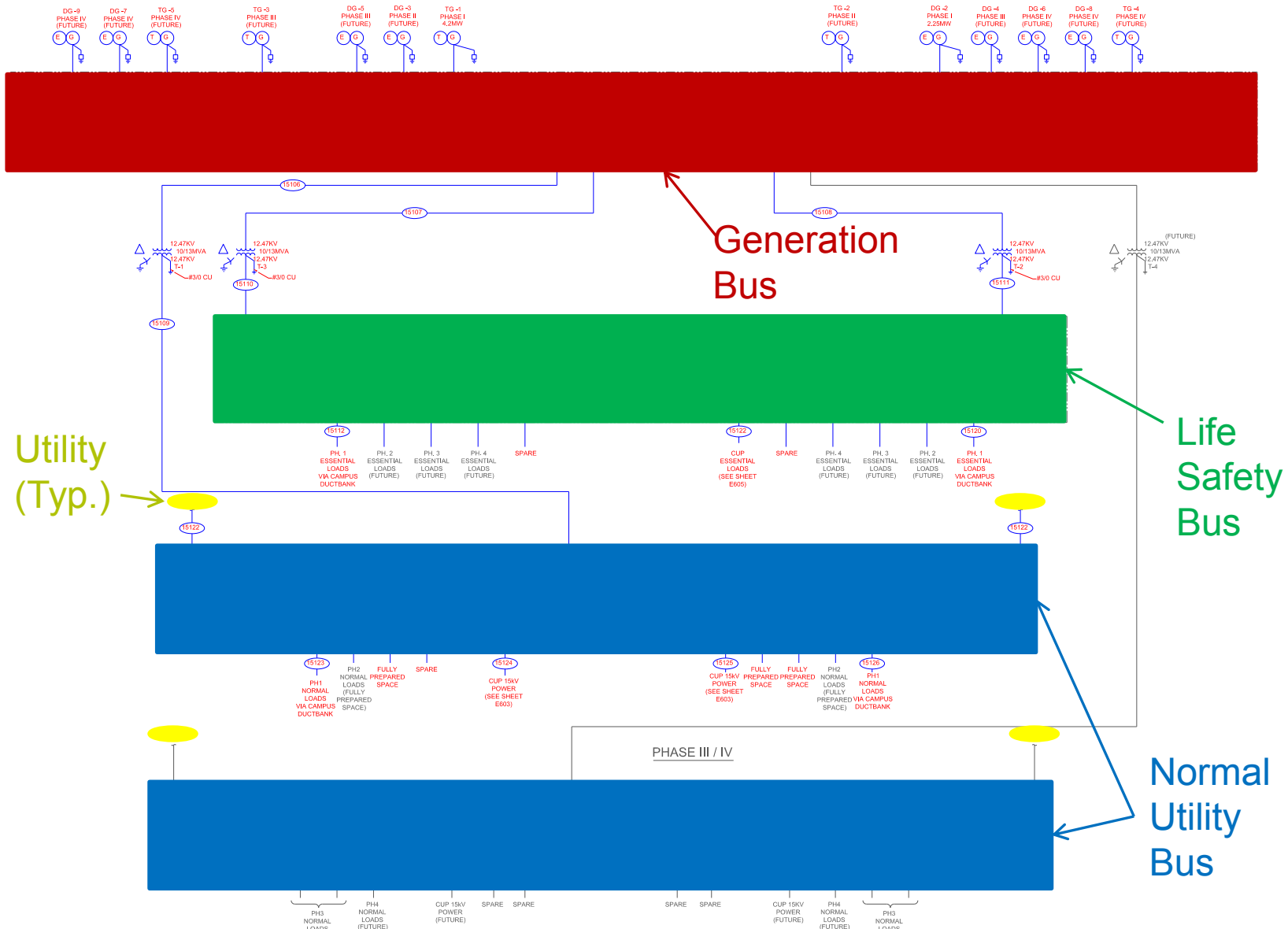
Hospital Issues to Address

- Traditional Generator Testing is Not Effective for Long Duration Outages
- Doctors & Nurses Don’t Want to Worry About Power
- Cost Efficient Usage of Power is Critical

Shands / GRU South Energy Center

- Partnership Between Hospital and Municipal Utility
- Combined Heat & Power for Efficient Generation of Utilities
- Multiple Levels of Redundancy
- Ability to Island

Energy Center One Line



Energy Center Benefits

- Fully Load Diesel Generators During Testing
- CHP Yields 80% Efficient Operation
- Proactively, Manually Island Campus
- Automatically Island Campus for Utility Disturbances

Thermal Energy Corporation & Texas Medical Center

Texas Sized Numbers

- TECO Serves 18 Million Sq Ft of Space Within the 52 TMC Member Institutions
- 120,000 Ton Chilled Water Capacity (Provisions for 48,000 Tons in Future)
- 900,000 lb/hr Steam Generation
- 48MW CHP Turbine
- 16MW Diesel Backup

TECO Operation

- Operating in Deregulated Market Within ERCOT
- Bidding into Day Ahead Market
- Dynamically Changes Energy Mix Based on Market Conditions
- Thermal Storage Tank for Additional Flexibility

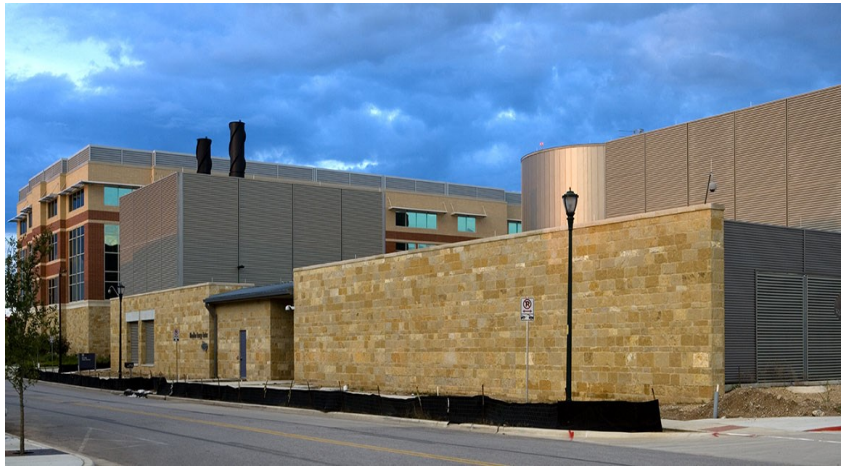
Microgrid Benefits

- $4 Million Savings in Utility Cost in 2012
- Able to Shore Up Local Grid During Periods of Weakness
- Ability to Island for Total Failure of Electrical Grid

Austin Energy Robert Mueller Energy Center
Dell Children's Hospital – Austin, TX

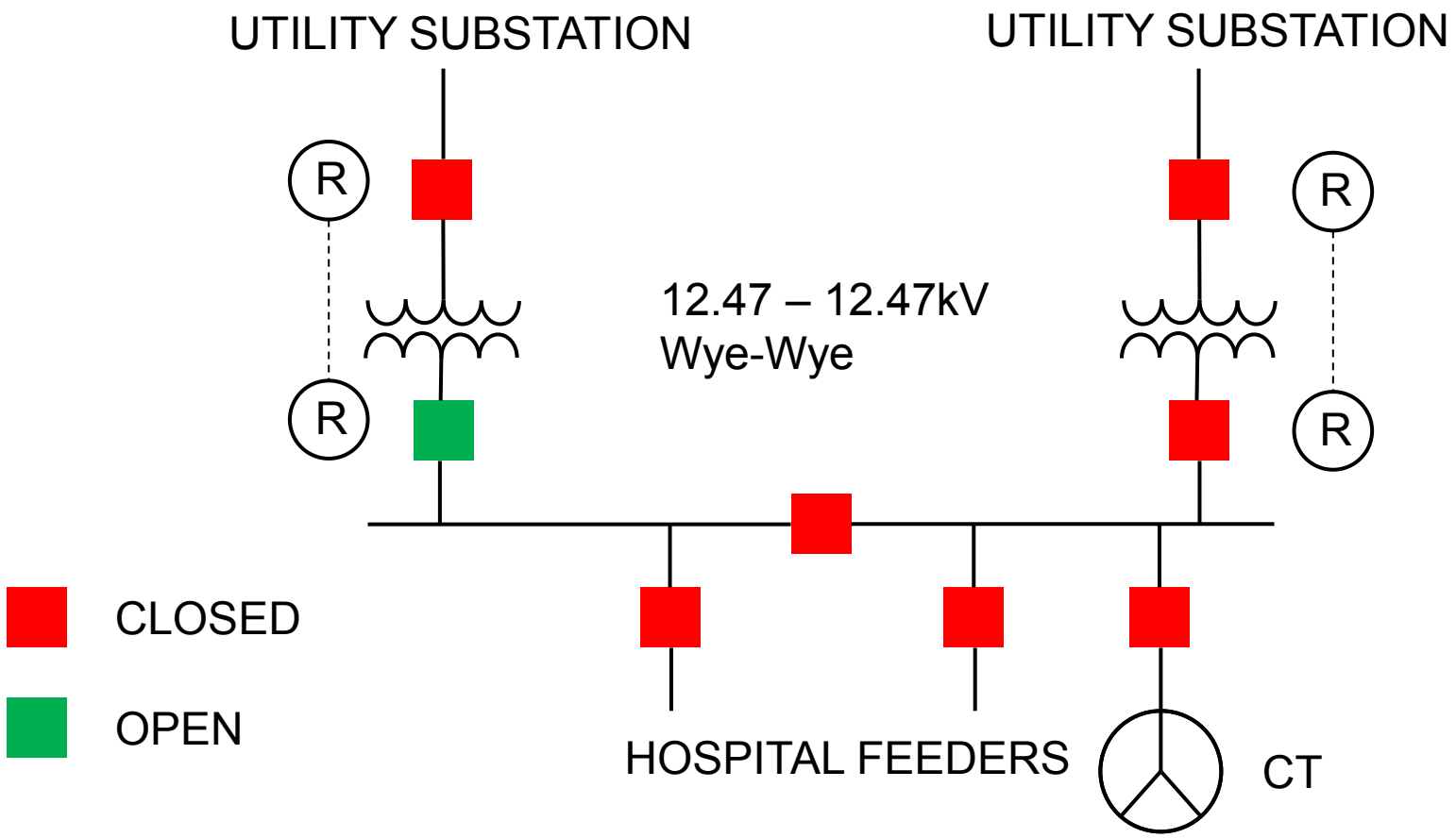
Overall Project

- Solar Mercury 50 Combustion Turbine – 5MW
- 35,000 lb/hr Steam Capacity
- Primary Distribution
- Emergency Generation



Initial Utility Interconnection

– Initial Operation – Single Utility Feeder

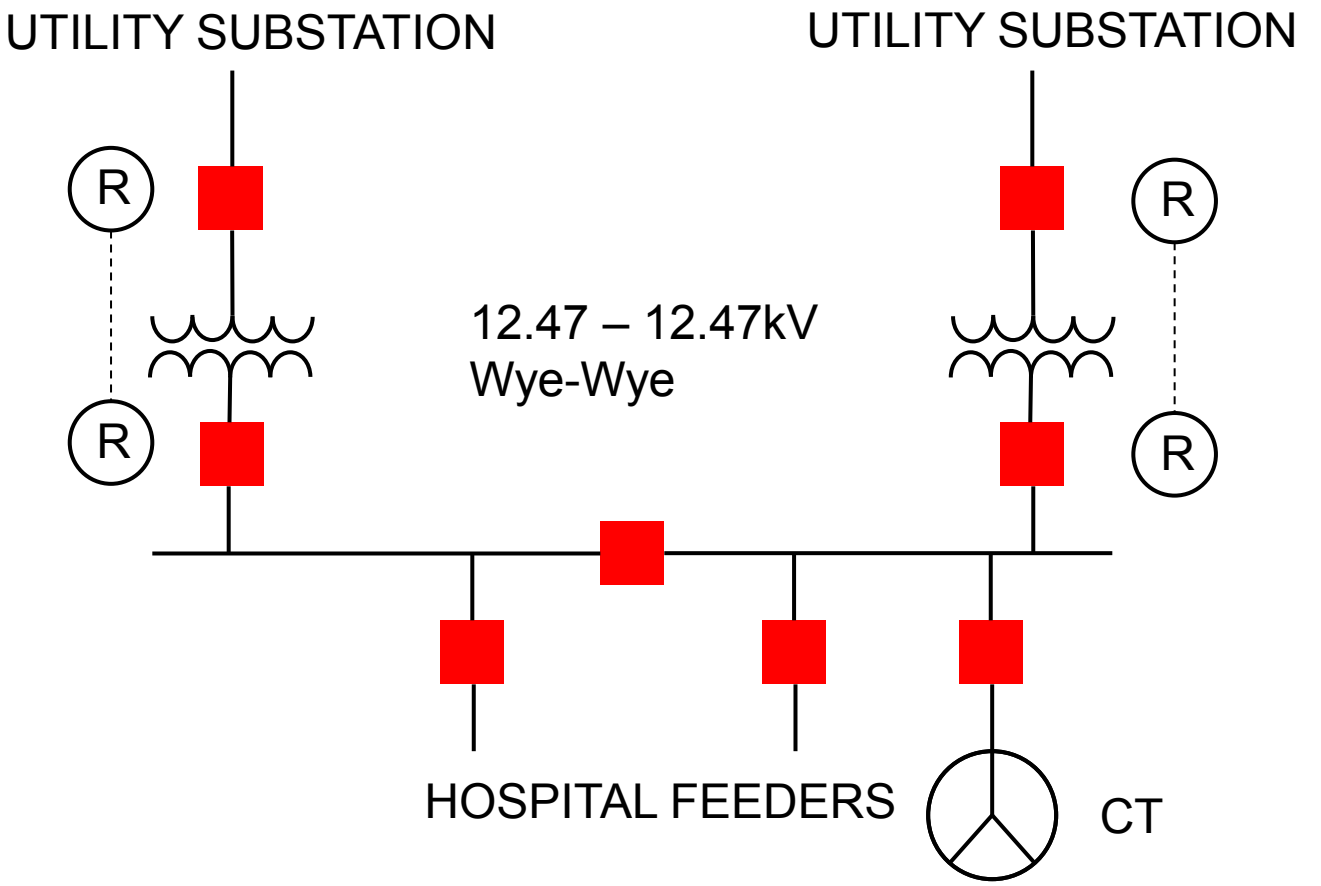


Challenges

- Reliability Issues
- Frequent Momentary Utility Outages
  - Overhead Exposure
- Transition to Island Mode Not Always Successful
- CT Contribution to Faults Caused Trips

Modified Operation

– Modified Operation – Dual Utility Feeders



Reliability Improvements

- Significant Reliability Improvement
- Same Number of Momentary Utility Outages
- Faults Cleared Quickly
- Automatic Reclose on Utility Return
  - Transparent to Plant Operators

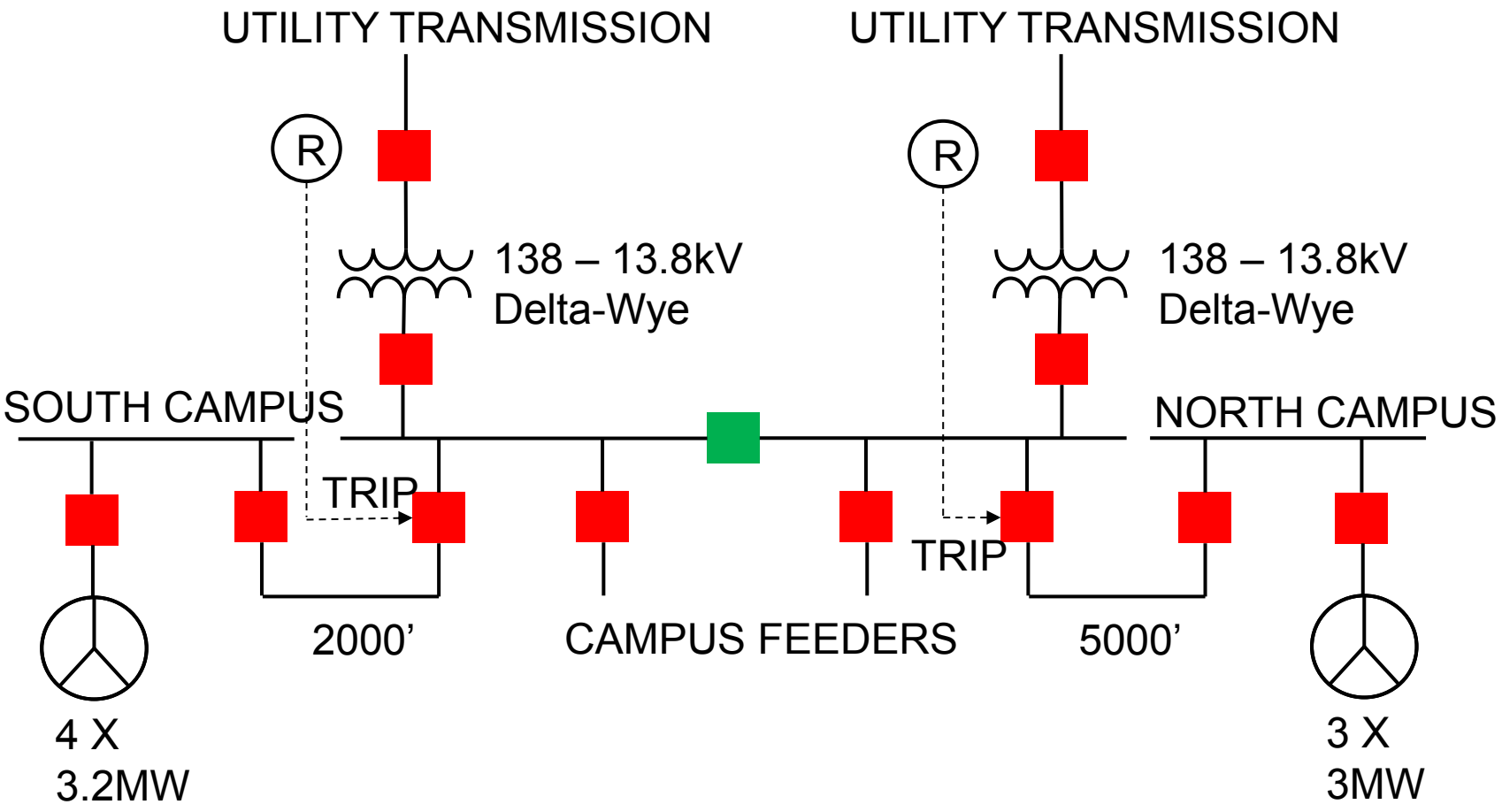
UT Southwestern Medical Center at Dallas – Dallas TX

Original Project

- 3 CAT NG Recip – 3MW Each
- 4 Deutz NG Recip – 3.2MW Each
- Transmission Interconnect
- 21.8MW Distributed Peak Shaving
- Campus Load Exceeds Generation Capacity

Initial Operation

– Trip Campus Feeder

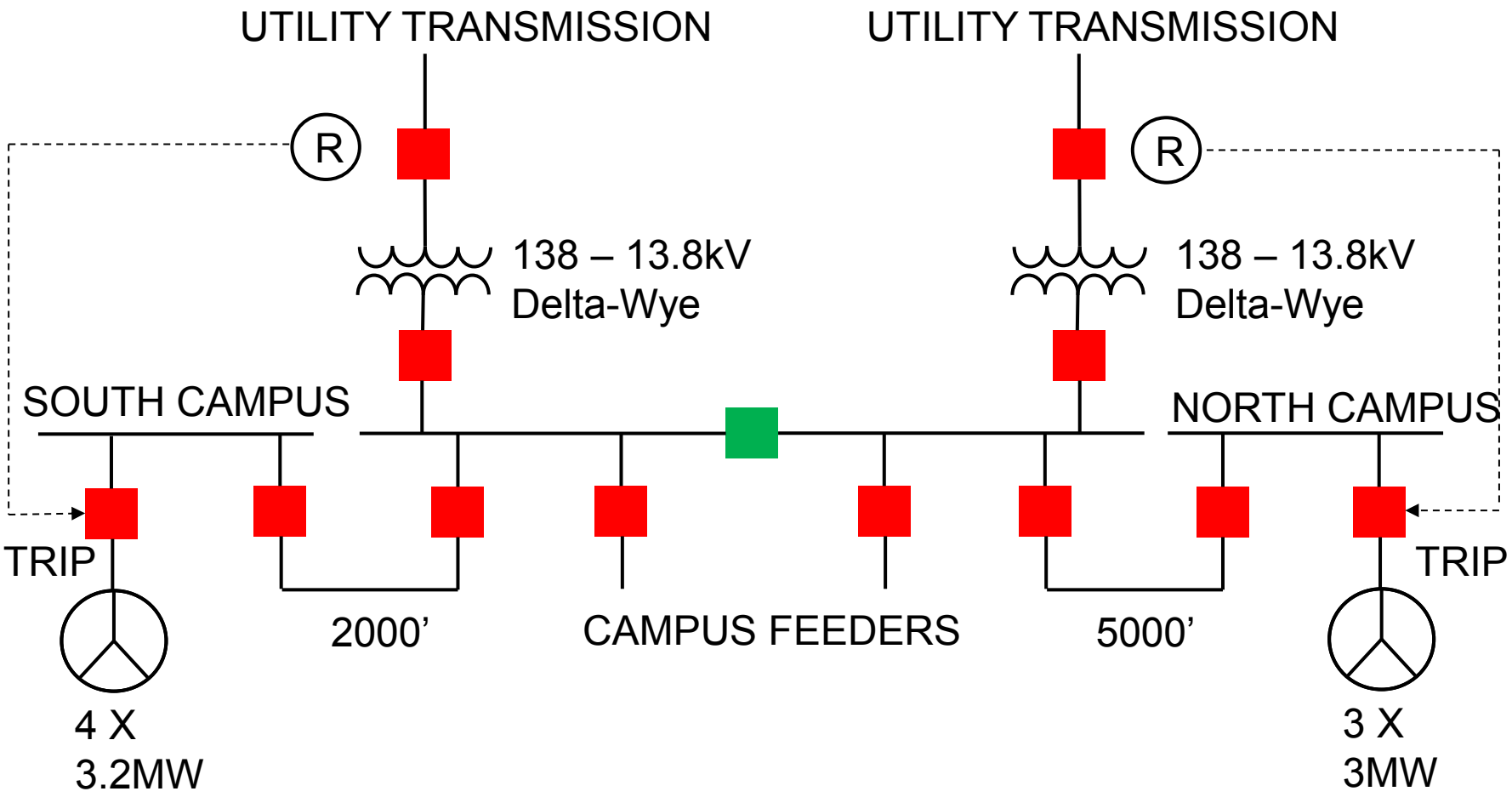


Challenges

- Reliability Issues
- Directional Overcurrent 50 Element Always Asserted
- Load Exceeds Generator Capacity – Generators Trip
- Campus-Wide Outage with Utility Available

Modified Operation

– Trip Generator Breakers Directly



Reliability Improvements

- Significant Reliability Improvement
- Eliminate Campus-Wide Outages
- Transmission System Very Reliable
- Generator Deployment Economic Only

Microgrid Mode

- Island Operation for Utility Loss
- North Campus – Isochronous
- South Campus – Baseload
- No Communication Required
- Significant Operator Actions Needed
  - Manual Load Shedding
  - Manual Load Restoration

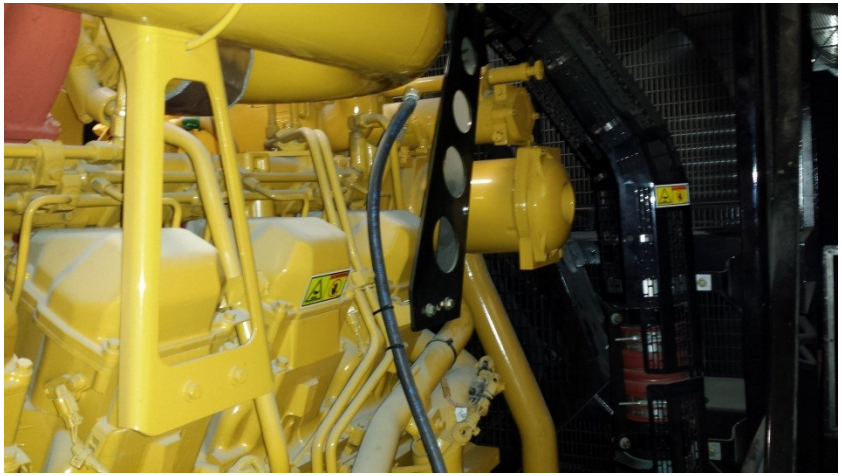
University of Iowa Backup Power Switching – Iowa City IA

Existing Generation Assets

- Numerous Individual Building Diesel Generators
- East Campus Power Plant
  - Three Steam-turbine Generators
  - 1500kW Emergency/Blackstart Generator
  - 4 – 2050kW NG Recip Generators – Under Construction

Existing Generation Assets

- Critical Building Diesel Generators
  - CBRB 1100kW
  - BSB 1500kW
  - MERF 1250kW
  - Water Plant 1250kW
  - Power Plant 1500kW
  - Total Rated 6600kW



Options Investigated

- Baseload Building Diesel Generators
- Loadshare Building Diesel Generators
- Recommendation
  - Loadshare
  - Modify Switchgear and Controls

Benefits

- Improved Operator Monitoring and Control
- Minimal Operator Dispatch
- Improved Transient Response
- Minimal Cost Difference

Microgrid Project Goals

- Every Project is Unique
- Leverage Existing Assets
- Minimize Cost
- Maximize Flexibility
- Keep Critical Facilities Online


ANY
QUESTIONS
?

Contact Us

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