David Robinson

david.robinson1@honeywell.com

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Converting a Fleet of Campus Standby Diesel Gensets (SDGs) into a Microgrid

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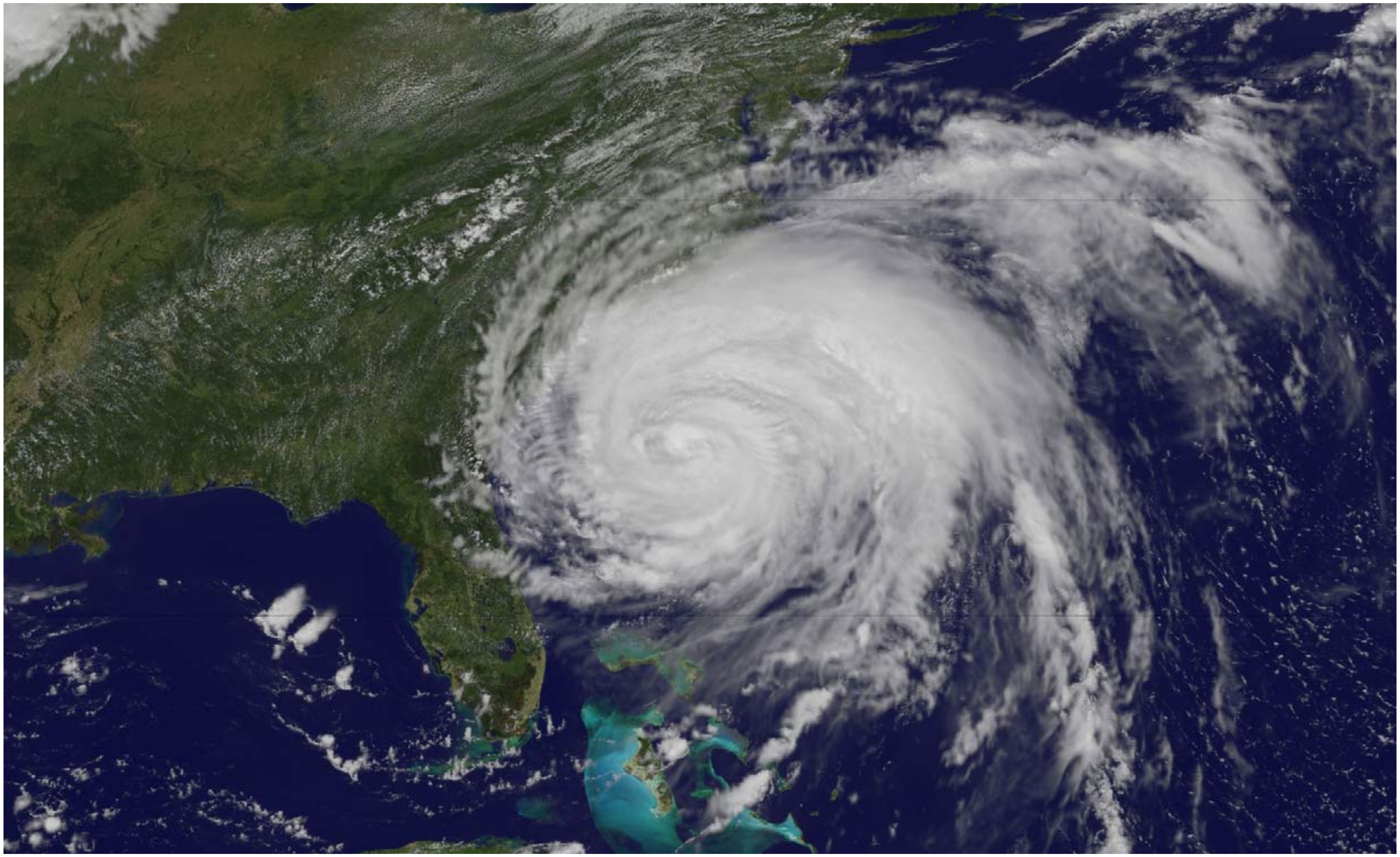
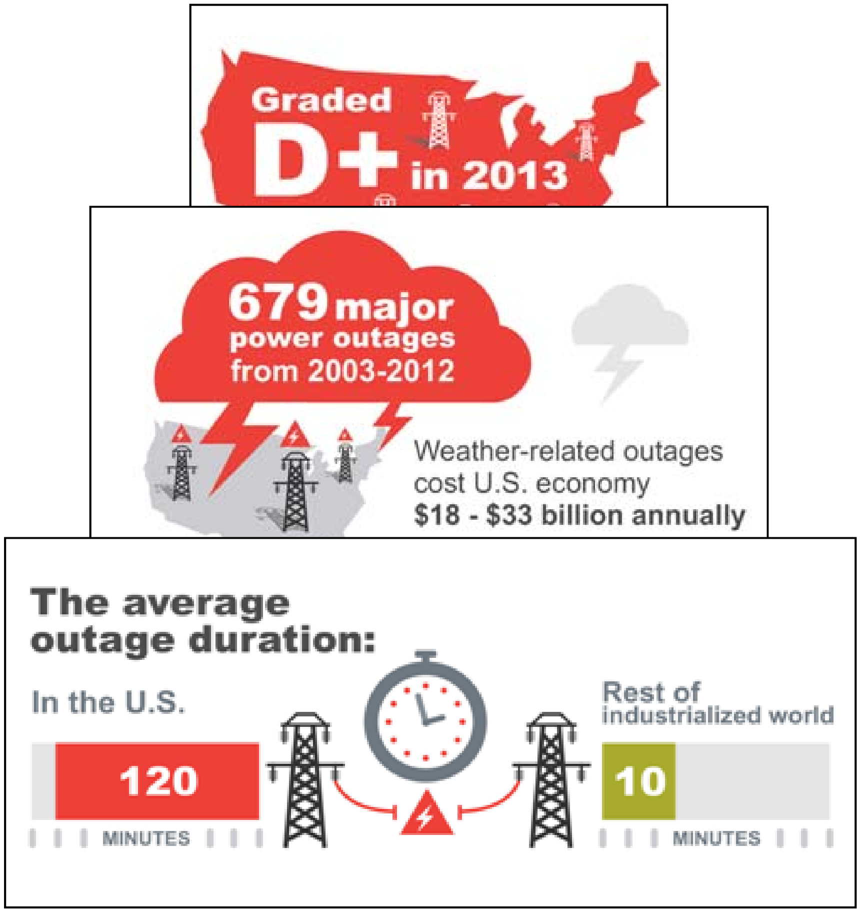
Areas of discussion include…

- Setting the stage – what is the situation and what is driving the behavior?
- Framing the problem – what are the technical challenges to the problem?
- Establishing an approach – how can the problem be solved?
- Deploying the model – where is the proving ground?

“The night the lights went out in NC”



New reality – energy surety is paramount



Improve Reliability

Control Energy Use and Costs

Protect Your Mission

Humble but lovable, standby diesel genset!

Pros:

- Installed in ‘bite-size’ chunks, modular
- Distributed installation (limits single point of failure)
- Diesel power adjusts quickly to changing load

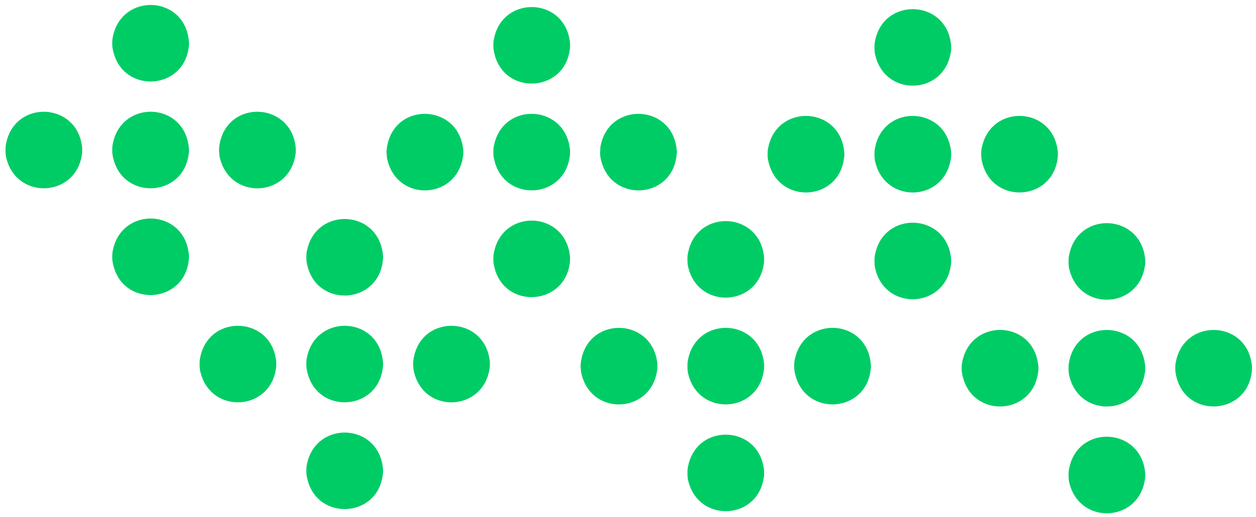
Cons:

- Limited fuel supply
- Frequently do not start (batteries)
- Transfer switch ‘interconnection’
- Typically oversized (for connected load)

But “what if”???

- Treat multiple SDGs as a single entity
- Leverage and optimize performance based on operating characteristics
- Improve efficiency to extend run-time (or couple with solar and natural gas gensets)
- Utilize all of the capacity of each SDG
- Improve means of interconnection

How do you make a microgrid?



- 30 buildings, 30 SDGs
- How should they be connected?
- How should they be controlled?
- Which one takes the lead?

This is a mighty complex problem!

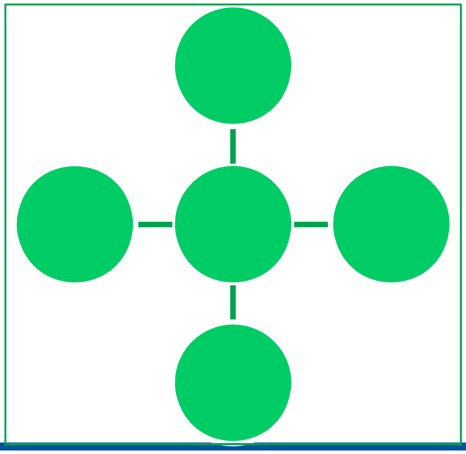
SNAPE concept – simplifies the problem

- Secure Network of Assured Power Enclaves (SNAPE)
  - Demonstrate a full-scale electric power microgrid system
  - Builds on existing technologies with a new way to control generators and other power sources
  - Helps improve protection of the microgrid from cyber attacks over the internet
- Benefits include:
  - Improves power reliability
  - Decreases electric bills
  - Lowers the costs to install a microgrid on military bases

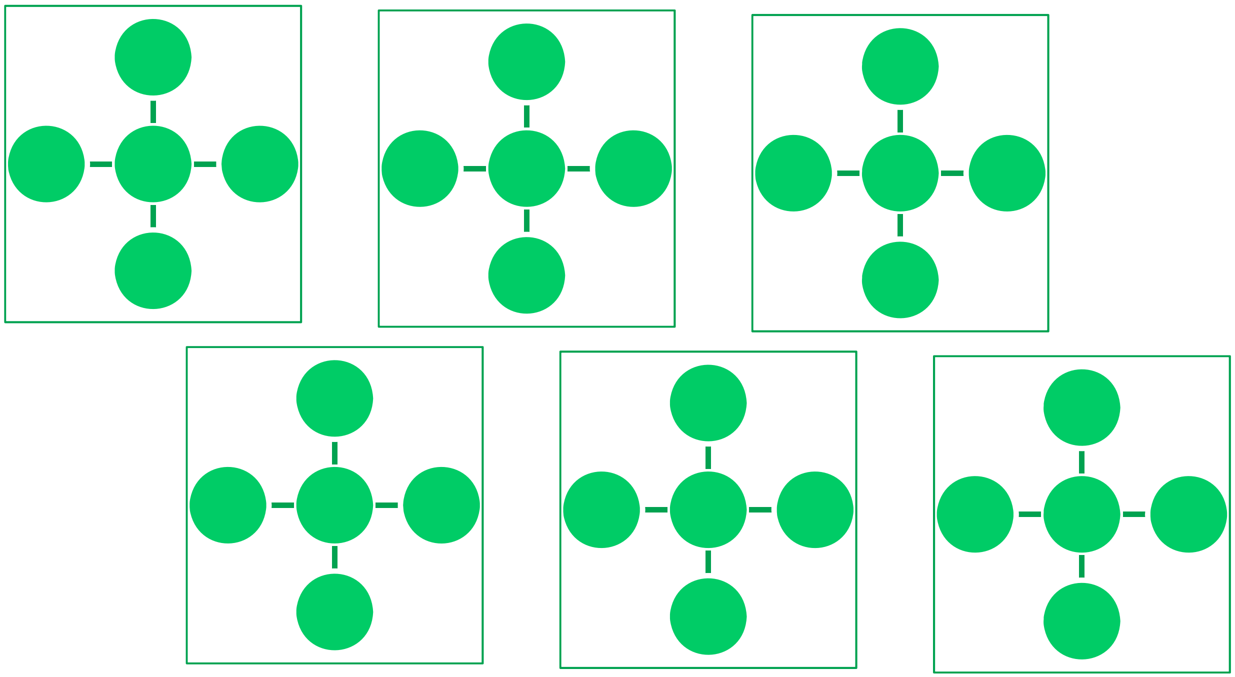
Create a number of power ‘enclaves’

Each enclave:

- can stand alone during an outage to share generation resources in a given area
- has a controller that controls the generation within the enclave providing stability and efficiency
- integrates available power from renewable sources and ensures stability by controlling load sharing and load shedding and restoration
- controls interconnection breakers at its boundaries so it can isolate itself and reconnect to the external EPS when the EPS is up and stabilized



SNAPE simplifies the problem



- Bundle them into enclaves of 5 SDGs per enclave
- Operate each one autonomously
  - Optimize start/stop, lead unit, balance loads
- Develop a single linkage between each enclave for added redundancy (if needed)

DEPLOYMENT #1 – UNIVERSITY CAMPUS

SCU Project Background

- Founded 1851
- 8,800 students, 106 acres
- Jesuit, Catholic university
- Sister to Loyola of New Orleans
  - Impact of Katrina, Fall 2005 (all classes cancelled)
  - What if? questions raised about SCU

SCU Project Features

- Promoted operation of entire campus “island” during outages via “self healing” architecture
- Integrates building automation systems for load controls and stability
- Leverages existing solar, wind, meters and building automation systems

- Key Innovations include:
  - Overcomes islanded renewable safety and intermittence issues
  - Does not depend on off-campus energy sources for 72 hour (and longer) grid outage
  - Hardened against cyber threats

SCU Project Stakeholders, Benefits

SVP/PG&E - Utility

- Lower brownout risk
- Improved system stability

State/Community

- Microgrid leadership
- **"Green"** disaster relief center
- "Island of stability"

University

- Operational in grid failure
- Improved efficiency
- Enhanced student safety

SCU Project Status

- Phase 1 – Main distribution upgrade – complete
  - New main inline switchgear that allows for remote operation
- Phase 2 – Secondary distribution location upgrade – complete
  - Convert remaining 5 kV primary to 12 kV
  - Allows for an integrated campus wide control scheme and make our distribution compatible with the enclave approach
- Phase 3 – target 2016
  - Integrates intelligent switching locations and the actual microgrid control topology
- Phase 4 – integration of SDGs and other onsite generation - TBD

DEPLOYMENT #2 – MILITARY CAMPUS

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Ft. Bragg, pop. 40,000

DoD's ESTCP funding

- Environmental Security Technology Certification Program
  - Environmental technology demonstration and validation program

Secure Network of Assured Power Enclaves (EW-201333)

Objective

The objective of this project is to demonstrate a full-scale electric power microgrid system at Fort Bragg, North Carolina. The Secure Network of Assured Power Enclaves (SNAPE) builds on existing technologies with a new way to control generators and other power sources. It also prevents the microgrid from being a victim of cyber attacks over the internet. SNAPE will benefit the Department of Defense (DoD) by improving power reliability, decreasing electric bills, and lowering the costs to install a microgrid on military bases.

SERDP DOD • EPA • DOE | ESTCP

Ft. Bragg ESTCP project addresses:

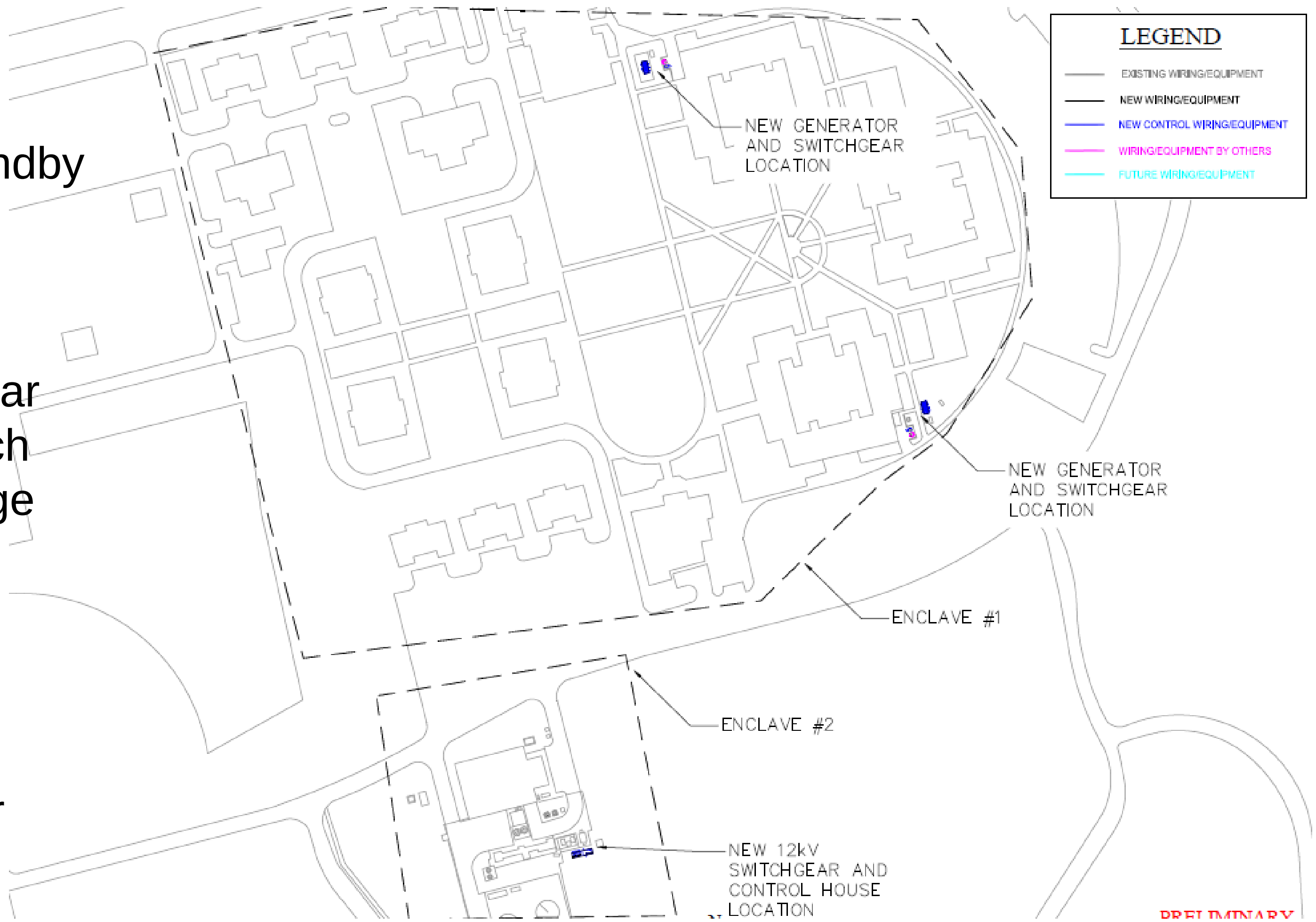
- Capital: Capital constraint when buying SDGs 1:1
- Efficiency: Oversized standby diesel gensets (SDGs) that are not fuel-efficient
- Redundancy: Single point of failure makes building vulnerable
- Resiliency: Existing 5.6 MW CHP system unable to island

There are over 50 MW of SDGs within Ft. Bragg!

Project area of interest

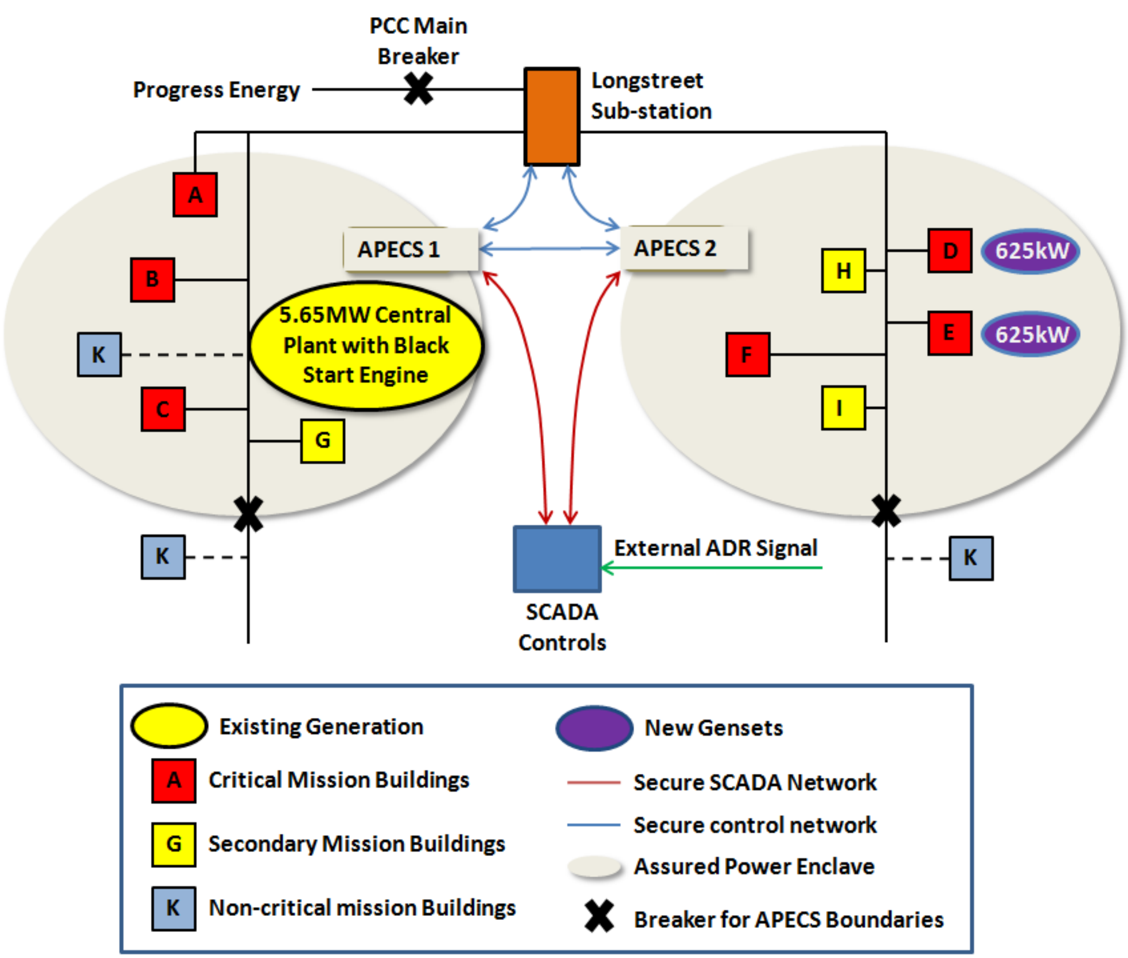
Two distinct ‘enclaves’

- Enclave 1 -
  - 2 @ >50MW standby diesel gensets (120/208V), fuel tanks
  - Parallel switchgear (<u>not</u> ATS) for each with relay package
  - Relocated pad-mounted transformers
- Enclave 2 - CHP
  - 12 kV switchgear



Operating approach, system diagram

- Operate natural gas combustion turbine CHP in island mode
- Use AutoDR to shed building loads
- Reduce fuel, O&M associated w/ SDGs
- Build enhanced cyber security networks (ACS Labs)
  - Network layer
  - Host-level layer



Progress update

- Contract executed - $3.4 million
- 30% design review complete
- Installation H1 2015
- Commissioning Q3 2015

Thanks for your attention and interest!

David Robinson

Phone: 941-704-5470

david.robinson1@honeywell.com