ENERGY.GOV
Office of
ENERGY EFFICIENCY & RENEWABLE ENERGY

Panel Session: End-User Experiences With CHP

Introduction to the Panel

Moderator: Patti Garland, CHP TAP Coordinator

Q & A will occur at the end of session
Questions for Panel Members
Please use chat function to Patti Garland

The Panel

Bobby Baird, SASHE
Director of Facility Operations,
UF Health Shands

With over 25 years of healthcare specific experience, Bobby Baird is a seasoned facility engineer with a wide range of department management responsibilities. He earned his Mechanical Engineering degree from the University of South Carolina. His experience includes for profit as well as not for profit health care organizations in the Carolinas and Florida, including a current role as Vice President on the Board of Directors for the Florida Healthcare Engineering Association.

Andy Lempera, P.E.
PBNA Supply Chain Sustainability Director

Andy Lempera is a director of sustainability for PepsiCo, where he has worked for 10 years. Prior to PepsiCo he was a consulting mechanical engineer for 10 years. Andy has a B.S. in Mechanical Engineering from Purdue University in West Lafayette and a masters in Energy Engineering from University of Illinois in Chicago. He is a licensed professional engineer and lives outside of Chicago with his wife and two children.

Joan Kowal
Sr. Director,
Resilience and Utility Strategies

Joan Kowal is the Senior Director of Resilience and Utility Strategies at Emory University, a position within Campus Services created to more closely align the planning and design of all utilities for the Emory Enterprise while focusing on meeting resiliency and sustainability objectives. Prior to her employment at Emory, she was the Energy Manager at the University of Maryland, College Park, as well as the Energy Advisor for the entire University System of Maryland. She currently serves on the Board of the International District Energy Association; is a Mechanical Engineer from Bucknell University; a Certified Energy Manager and received her Professional Engineers License from the State of Georgia.

CHP
UF Health & GRU

For the engineers

- 4.3 MW recuperated combustion turbine
- 7.4 MW reciprocating engine generator
- 40 klbs/hr heat recovery steam generator
- Back-up boiler
- 4,200 Tons of cooling (up to 1200 free)
- 2.25 MW emergency diesel
- 500 kW black start diesel

UFHealth
UNIVERSITY OF FLORIDA HEALTH

Why CHP for UF Health

- Flexibility
- District energy
- Islanding
- Growth

Flexibility

- Grid
- Self generation
- Chilled water
- Change as needed for campus

District Energy

- Campus
- Manage reliability
- Make decisions
- Coordinate

Islanding

- Reliability
- Efficiency
- Priority

Growth

- Original design
- Stepped growth
- Diversity management

Why was the project attractive?

- Greenfield site
- Predictable and consistent thermal loads
- Distribution location
- Overall size
- Excitement of being a part of this type project

Benefits

- Island mode
- Capital avoidance
- Out of clean air act mode
- Backhoe – or not owning one
- Staffing
- Input on management
- Political
- Free chilled water & steam

Benefits

- Money stays local
- Infrastructure not mine
- Access to utility personnel
- Natural gas purchasing power
- TJC/surveyor
- Reliability
- Hospital concentrates on core business
- LEED Gold

Benefits

- Fully loaded generators during testing
- 80% efficient CHP operation
- Multiple levels of redundance
- Partnership with local utility company
- No power blip @ transfer

UFHealth
UNIVERSITY OF FLORIDA HEALTH

Lessons learned

- Different drivers in each industry
- Nothing is free
- Communication to O’s
- Cost vs. reliability
- Recognize timelines for equipment maintenance
- Use best engineers available
- 4 A’s

Lessons learned

- 4 A's
  - Authority
  - Accountability
  - Approval
  - Accessibility
- All in contract, all agreed to and all start with A

Questions

- Bobby Baird, SASHE
- bairdr@shands.ufl.edu
- 352-594-3720

Indianapolis Gatorade Combined Heat and Power System

Project drivers: reduce greenhouse gas emissions and utility bills

Project Partners – MacAllister Power Systems, Thermal Energy, Inc., Midwest Cogeneration Association

$6M Capital

$1.45MM Annual Utility Savings

$1.0MM Net Savings

35% Reduction in plant greenhouse gas emissions

- *At ~$400-500/MTCO2e investment, cogen is one of the best investments to reduce GHGs)*

Project Startup in January 2019

Project Overview

- Three 1700hp natural gas engines turning 1.2MW electric generators – 3.6MW total output
  - Provides >90% of plant's electricity usage
  - Reduces peak demand

World Class Efficiency by Utilizing Heat Recovery

- Heat generated by engines (cooling and exhaust) utilized for Gatorade processing
  - Reduces load on natural gas boilers
  - Reduces overall utility costs
- System efficiency 86%
  - Electrical efficiency 37%
  - Thermal efficiency 49%

Project Details - Generation

Generators utilize a control system to produce electricity based on plant load

Generators can efficiently run from 600kW to 1200kW

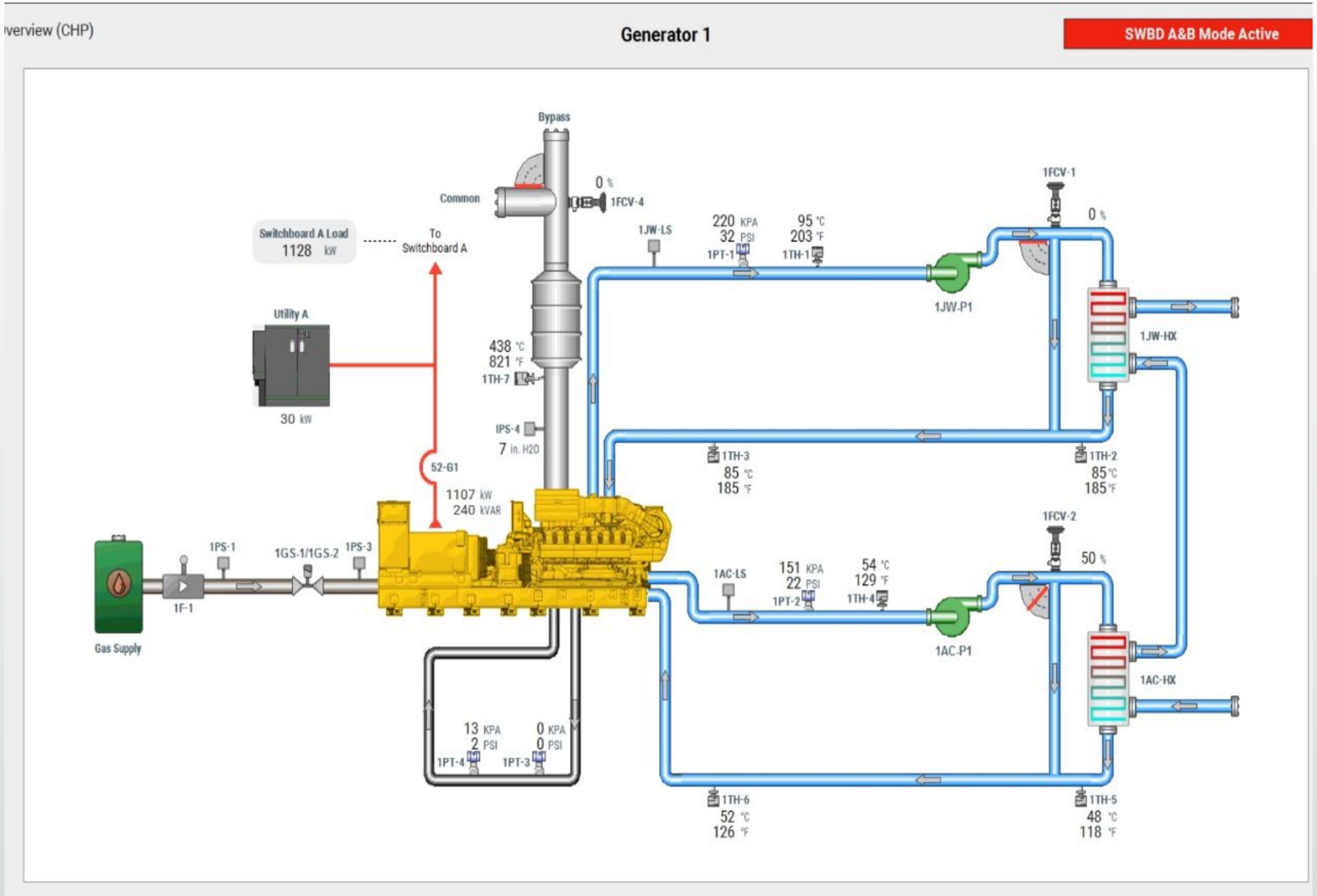
System is not designed to backfeed power to the grid

Reverse Power is acceptable in small amounts for brief periods of time

Reclosers needed to protect grid and IPL employees

SEL protective relays on plant side detect and trip cogen units prior to utility trip

IPL can lock out system in live line restriction event through cellular connection



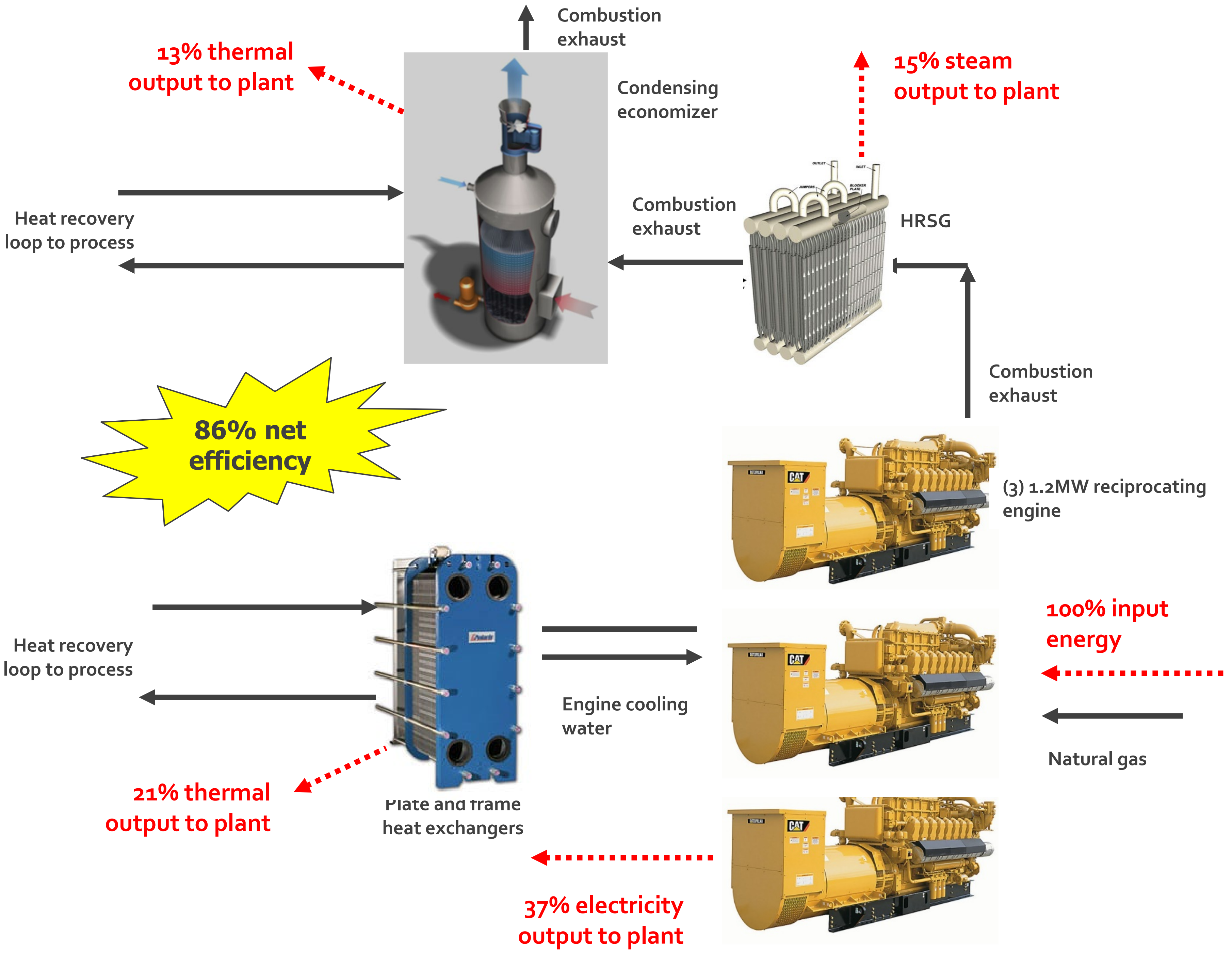
86% HHV net efficiency:

Economizer condenses water vapor from products of combustion (13% recovery)

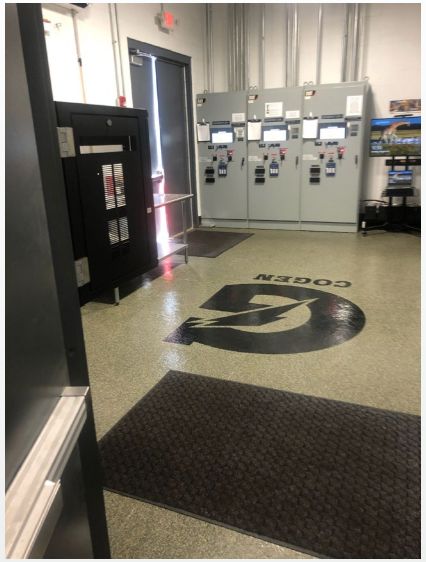
Heat Recovery Steam Generator creates 100 psig steam for process (15% recovery)

Plate & frame heat exchangers cool engine after-cooler and jacket water and use heat in process (21% recovery)

(3) 1.2 MW gensets (37% recovery)



Generator Building



Control Room

Generator Room

Steam Generator

Heat Recovery Pumps and
Heat Exchangers

Project Challenges

- Change in billing structure – demand vs. usage – charges changed from usage based to demand based with 11-month ratchet
- Interconnection extras – more protections than anticipated when project was developed (Reclosers, IPL lockout device, distribution engineering)
- "One-to-many" controls alignment
- Generator cooling and heat recovery optimization (currently work-in-progress)

EMORY UNIVERSITY

EMORY UNIVERSITY

- Located in Atlanta, GA (largest employer in the metro Atlanta area)
- 15,451 enrolled students – undergraduate and graduate
- 32,824 employees- University and Healthcare
- Approximately 9 million square feet; 130 buildings
- Utility budget of approx. $35M excluding Healthcare
- 20kV Emory owned electric distribution system supplied by two Georgia Power substations
- 42 MW peak demand
- Three Central Chiller Plants serving approximately 75% of campus; 20,300 tons capacity
- Central Steam Plant; 500,000 pph capacity

EMORY UNIVERSITY

EXISTING CHP - STEAM TURBINE GENERATOR

- With very low Georgia Power energy rates and no significant demand charges, a large base loaded combined heat and power plant has not penciled out economically
- Emory made a committed focus in our 2015 Sustainable Visioning Goals for self-generation, and targeted 10% by 2025
- With a needed 100,000pph boiler replacement in 2017, little additional capital was required to install a boiler with a higher operating pressure and a 1MW steam turbine generator was added.
- Design is very similar to a heat recovery steam generator (HRSG) with a back-pressure steam turbine
- The STG allows the steam plant to operate with an additional boiler on a loss of utility power to increase resilience for the campus and newly added hospital addition.

PROPOSED MICROGRID

- In 2017, Emory initiated discussions with GA Power (GPC) with regards to improving our electric infrastructure resiliency.
- Emory pursued an option similar to a recent project by Clemson University with Duke Energy that located the CHP on the utility's system but sold steam to the University.
- Emory asked the Public Service Commission (PSC) for approval to allow GPC to support a community microgrid that would provide resiliency to critical facilities at Emory and the surrounding neighborhood.
- The PSC, while supportive of the community microgrid concept, ruled that there was not enough information to approve the microgrid under the IRP final stipulation because of uncertainty related to overall ratepayer benefit.

PROPOSED MICROGRID

- The original proposed microgrid project would be located adjacent to a GPC 115kV/20kV substation and interconnected to the GPC distribution system electrically and connected to the Emory steam distribution system.

- Base Microgrid design includes:
  - approximately 10MW base load CHP;
  - steam connection to two Emory radial steam headers converting them to a loop
  - 1.5MW solar canopy on adjacent parking garages
  - Future battery storage to complement solar capacity

- Microgrid would replace 2MW of standby diesel generation at the Emory data center and 2.5MW of standby diesel generation at the new Health Science Research Building.

MICROGRID PHASE I

- Emory carved out a Phase I to the project that focused on behind the meter generation at HSRB in place of a traditional standby diesel generator.
- Phase I requested generator(s) and control proposals that allow for seamless parallel operation with no export to the GPC distribution service as well as future compatibility to a possible 20kV microgrid expansion.
- The required heat load at HSRB as well as the GPC real-time pricing did not support baseload operation but provisions include future jacket water heat recovery.
- There also provisions to include controls that allow for continued operation of solar PV that will be installed at HSRB-II as well.
- Emory received numerous responsive proposals for the project and are encouraged that the market is responding to end-user focus on distributed energy resources that include CHP

MICROGRID PROPOSALS

- Requirements were based on available physical location; ability to operate in parallel with utility power for up to 1000 hours; ability to seamlessly island and shed load to keep generation operating; ability to blackstart on a loss of utility power; ability to meet life safety loading requirements.
- Proposals were evaluated based on the following:

Evaluation Category	Weighting
Resiliency	2
Economics	2
Partner Value / Experience	1
Technology	2
Ease of Operation/Maintenance	1

EXAMPLE:
PROPOSED MICROGRID SYSTEM

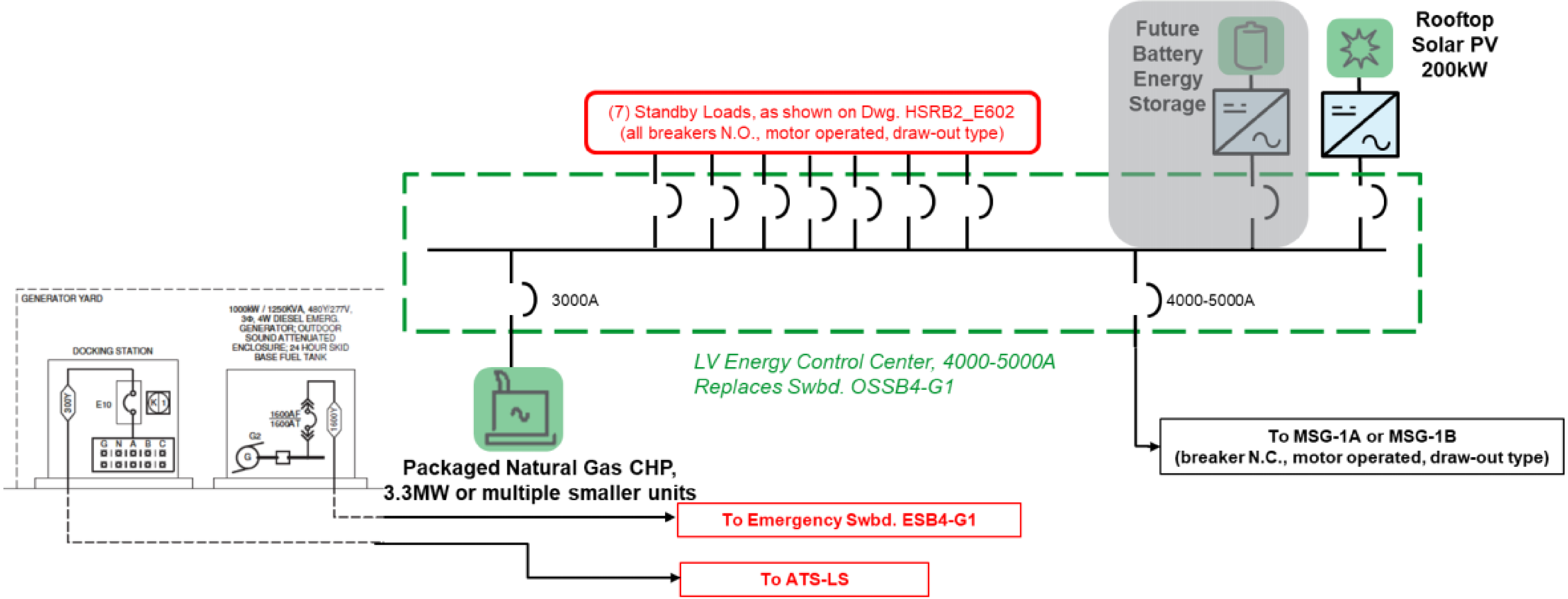


Figure 11. Proposed Microgrid System using CHP and Energy Control Center in place of Standby diesel generator and switchboard.

HIGHLIGHT OF PHASE I MICROGRID

- **Resiliency:** Multiple engines; allows for longer term operation with natural gas supply; parallel operation improves reliability of engines; allows for future incorporation into larger microgrid
- **Sustainability:** Heat recovery improves efficiency, lowers GHG emissions; natural gas lower GHG than diesel – allows for future use of renewable natural gas; incorporates solar generation into microgrid
- **Economics:** Lowest total cost of ownership; allows for third party financing to reduce Emory up-front CapEx; allows for additional savings for operation in high priced hours

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Speakers:

Bobby Baird, University of Florida Health, Shands Hospital

Andy Lempera, PepsiCo Gatorade Plant

Joan Kowal, Emory University