De-Carbonizing the Campus: Planning, Tools & Technologies

CampusEnergy2023

February 27 – March 2, 2023

Gaylord Texan Resort & Convention Center | Grapevine, Texas

INTERNATIONAL DISTRICT ENERGY ASSOCIATION

Gallaudet University Microgrid

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GALLAUDET UNIVERSITY

Gallaudet University, located in Washington D.C., is the premier institution of learning, teaching and research for deaf and hard-of-hearing students.

The Solution:

Gallaudet has partnered with Scale Microgrids to build a **world-class, clean energy microgrid** on its campus in Washington D.C.

Project Execution Partners:

Urban Ingenuity and **CHA Consulting**

- **Urban Ingenuity oversees project execution**, ensuring integration of property owner objectives within implementation.
- Under contract to Scale Microgrids, **CHA Consulting serves as Engineer of Record (EOR)** on the project.

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Project Goals

MAXIMIZE COST EFFECTIVENESS FOR UNIVERSITY

PROVIDE RESILIENCY & COMMUNITY SUPPORT

IMPROVE FACILITY OPERATIONS & MAINTENANCE

REDUCE GHG EMISSIONS

CASE STUDY

Gallaudet University Clean Energy Microgrid

Gallaudet's unique microgrid will work in parallel with the district's local utility to power the campus in Washington, D.C. In the event of a grid outage, the system will provide nearly all the University's electricity needs, allowing campus operations to continue with minimal disruption.

GALLAUDET UNIVERSITY

CONNECT. DISCOVER. INFLUENCE.

Project Goals

- Reduce GHG emissions
- Provide Resiliency + Community Support
- Maximize financial benefit to University

Electricity generated by the solar arrays will be available to Washington, D.C. residents, nonprofit organizations, and small businesses through the DC community solar program. Through this offering, as many as 1,500 nearby households or small businesses that lack the roof space or capital to install solar panels will be able to purchase solar energy generated at GU.

GU's Microgrid Capacity

- 2.5 MW Solar PV across campus rooftops + garages
- 1.2 MW/2.5 MWh Tesla energy storage system
- 4.5 MW combined cooling, heat and power system
- Advanced microgrid controls

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Community Solar System

Through extensive collaboration with PEPCO, GU will export all of the energy generated by on-site solar into the D.C. Community Solar Program.

CLEAN POWER FOR THE COMMUNITY

REDUCED GRID CONGESTION

INCREASED SYSTEM ECONOMICS

“Virtual Front-of-the-Meter” Approach

TYPICAL COMMUNITY SOLAR PROJECT

- On-site solar arrays need to connect directly to the grid.
- Adds considerable cost and time during project development

GU’S COMMUNITY SOLAR PROJECT

- Solar arrays simply connect to the nearest power panel
- PEPCO then tracks the output through sensors and software

The virtual front-of-the-meter approach eliminates the need for extensive cabling to the main grid, reducing overall time and cost of project development.

Mechanics

- CCHP System
- Steam Generation
- High Temperature (HT) Loop & CHW Generation
- Low Temperature (LT) Loop
- Space Constraints
- Overall Performance

CCHP System

Feedwater

100 PSIG Steam
Campus Heating

750°F

376°F

HRSG (3)

EXHAUST

229°F

Exhaust Gas
Heat
Recovery (3)

Load Following (Electrical)
Base Loaded Operation
(Thermal)

Fuel Consumption
40.4 MMTU/hr (HHV)

Steam Generation 5,664 lb/hr

1.5 MW
RICE (3)

194°F

180°F

Future
Users

Heat
Rejection

LT Loop 5.2 MMBTU/hr

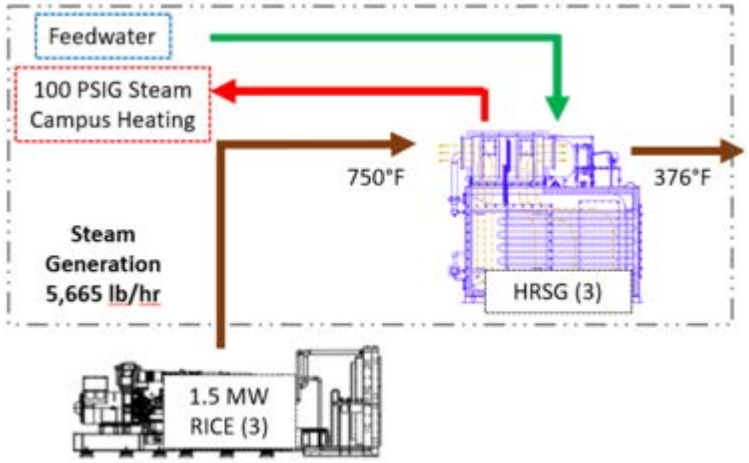
Heat
Rejection

HT Loop 6.9 MMBTU/hr

HW ABO
(520 Ton)

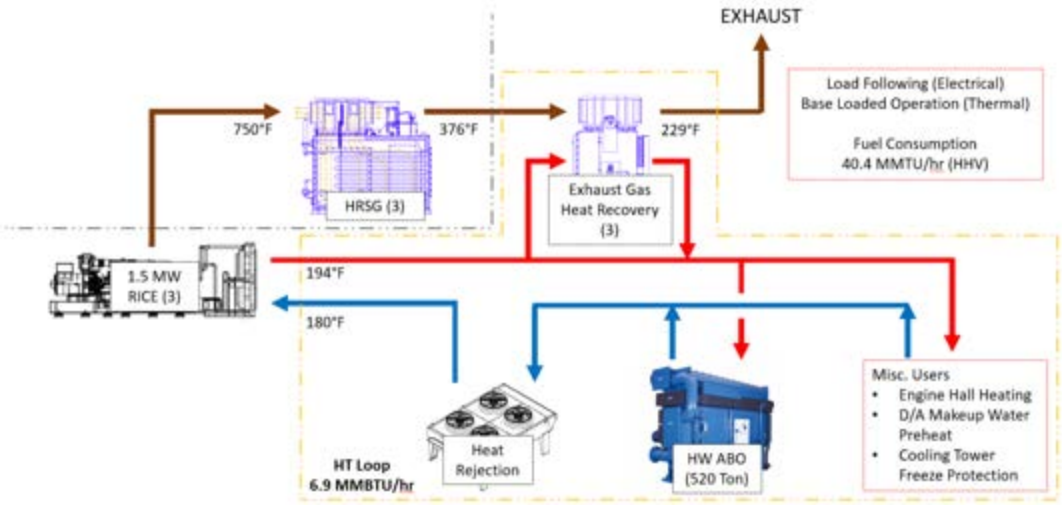
Misc. Users
- Engine Hall Heating
- D/A Makeup Water Preheat
- Cooling Tower Freeze Protection

Steam Generation



- Three (3) HRSG units -> 100 PSIG Steam
- Nominal Generation 3 x 1,888 lbs/hr @ 100% rated engine output
- Minimum site demand 6,000 lbs/hr
- Base load steam demand supplemented with auxiliary boilers as necessary
- Capacity based on economic sizing of equipment – 33°F pinch

High Temperature (HT) Loop & CHW Generation

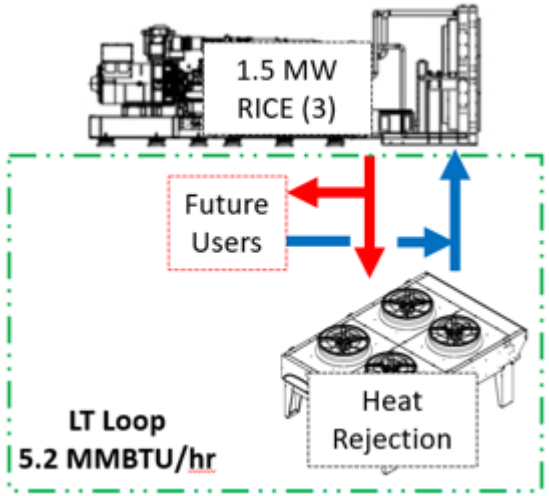


Summer Users	Winter Users
ABO (primary user 6.7 MMBTU/hr)	Engine Hall Fresh Air Preheat (1.1 MMBTU/hr)
D/A Makeup Water Preheat (0.2 MMBTU/hr)	Cooling Tower Freeze Protection (2.0 MMBTU/hr)
	D/A Makeup Water Preheat (0.2 MMBTU/hr)

- Jacket water heat recovery & exhaust heat recovery
- Three (3) Exhaust Gas Heat Recovery (EGHR) Units
- 4.6 MMBTU/hr – Jacket Water Heat Recovery
- 2.3 MMBTU/hr – EGHR Units

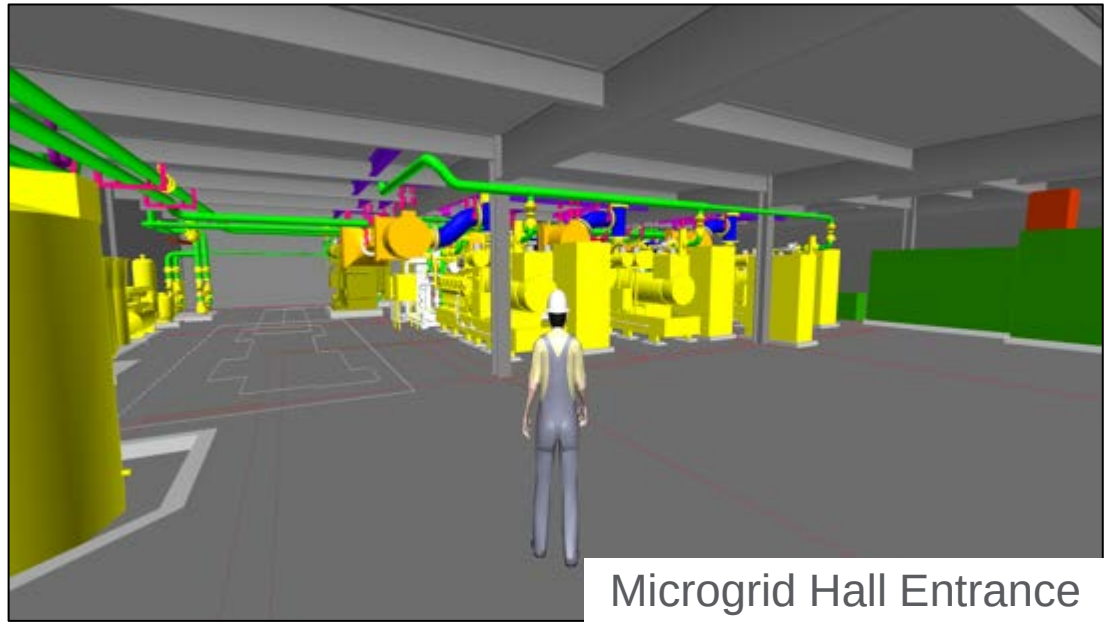
- One (1) 418 Ton Nom. Absorption Chiller (40% PG/60% Water)
- Max capacity 520 Ton
- Optimized COP based on heat available; Max. COP = 0.82
- Located in open chiller bay

Low Temperature (LT) Loop



- Low temperature ~130°F (engine out)
- Valuable source of heat when utilized correctly
- Provisions for tying into LT loop for use with future users implemented

Space Constraints



Microgrid Hall Entrance

- Converted existing carpentry workshop and storage for microgrid space ~6,200 sq.ft. (excl. ABO bay)
- First floor in existing three floor CUP
- All thermal generation assets located in microgrid hall
- Incorporated new ventilation, anti-vibration, fire proofing, and sound attenuation

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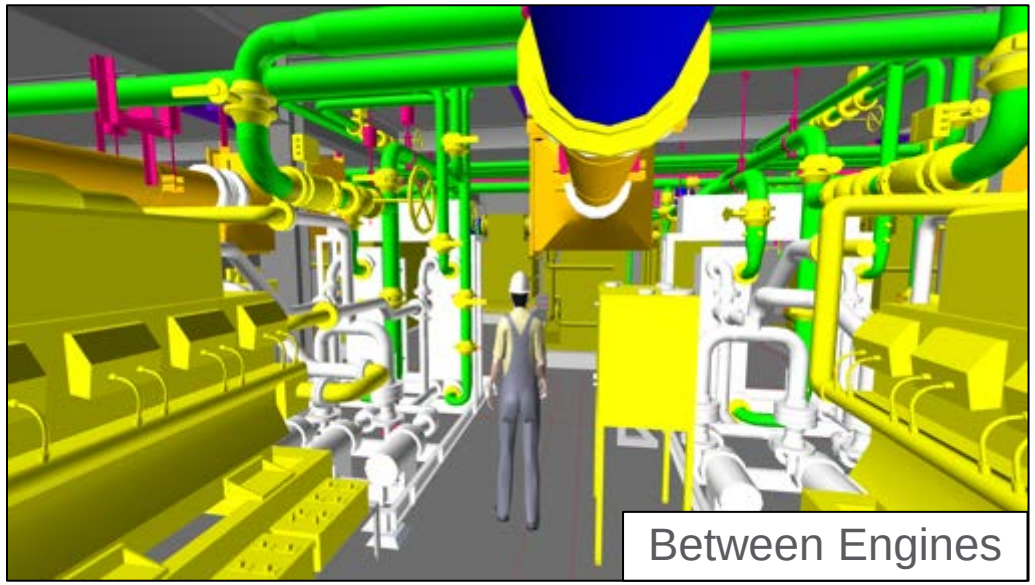
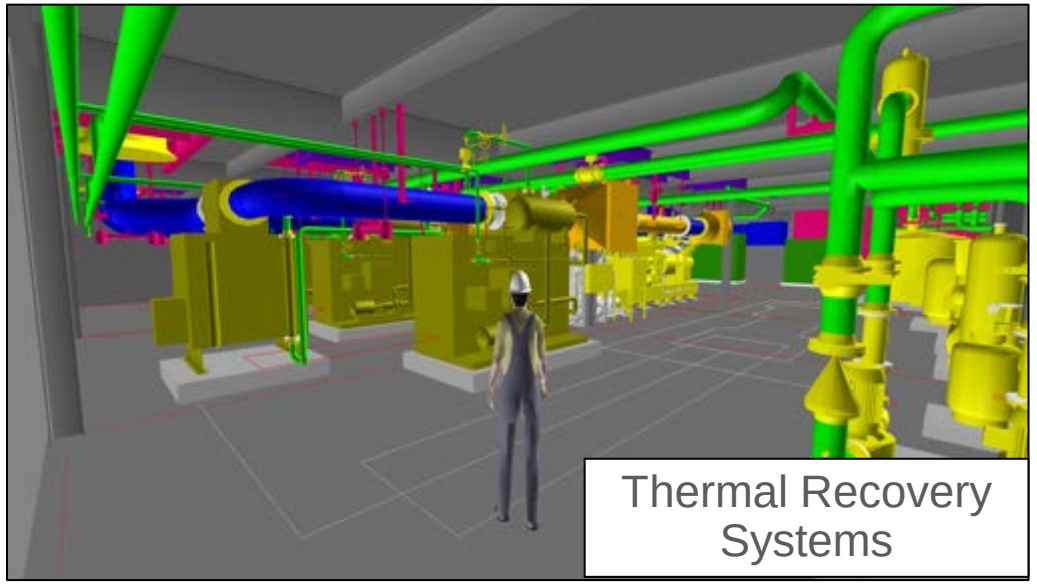
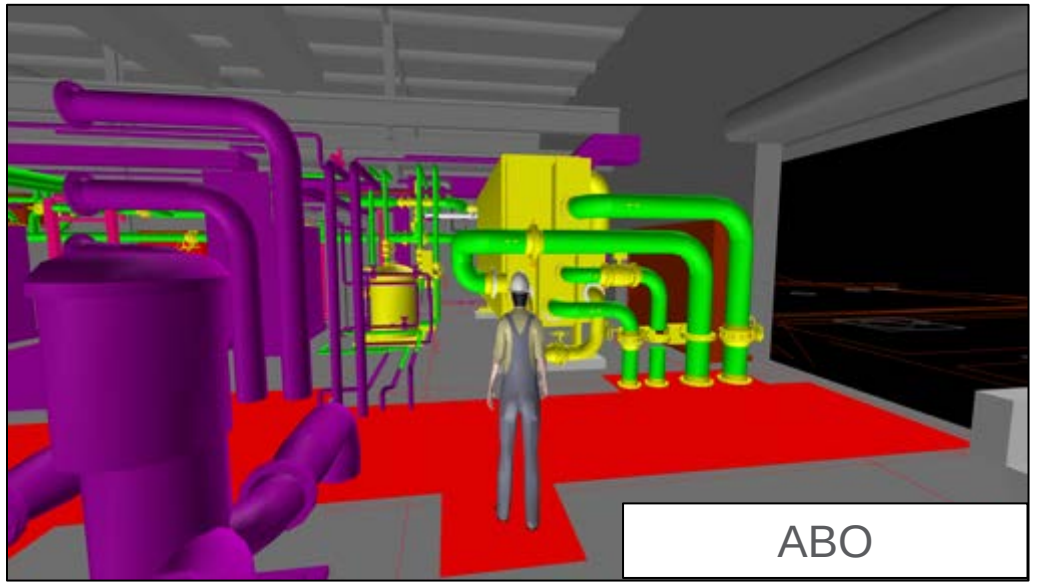
Space Constraints



Between Engines



Thermal Recovery Systems



ABO

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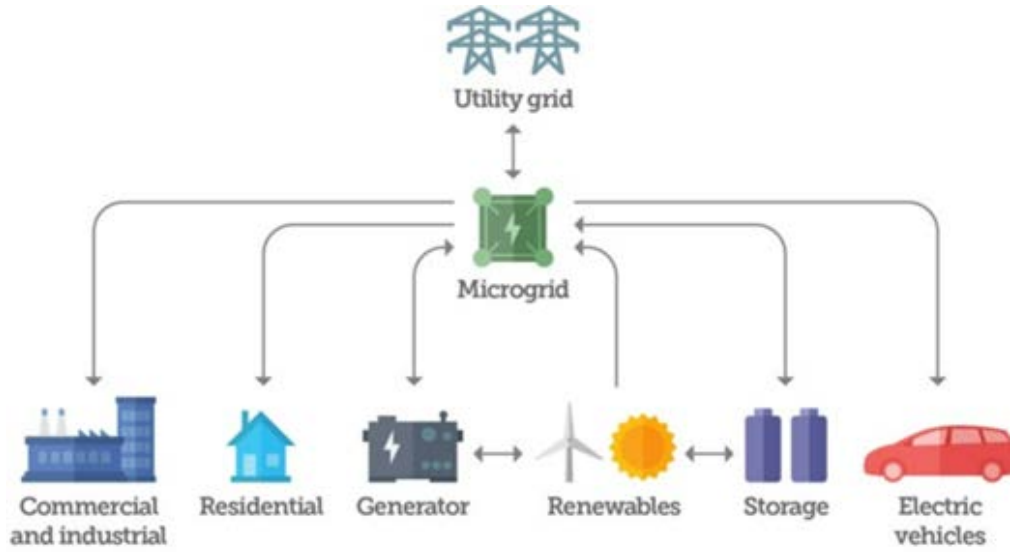
Overall Performance

Parameter	Avg. Summer	Avg. Winter
Gross Generation	4,500 (100% Load)	3,999 kW (88% Load)
Fuel Consumption (HHV)	40.4 MMBTU/hr	36.4 MMBTU/hr
100 PSIG Steam Production	5,664 lb/hr	5,664 lb/hr
HT Loop Thermal Energy Utilized	6.85 MMBTU/hr	3.3 MMBTU/hr
Cooling Tons*	418	0
Total CCHP Efficiency (HHV)**	69.6%	62.8%

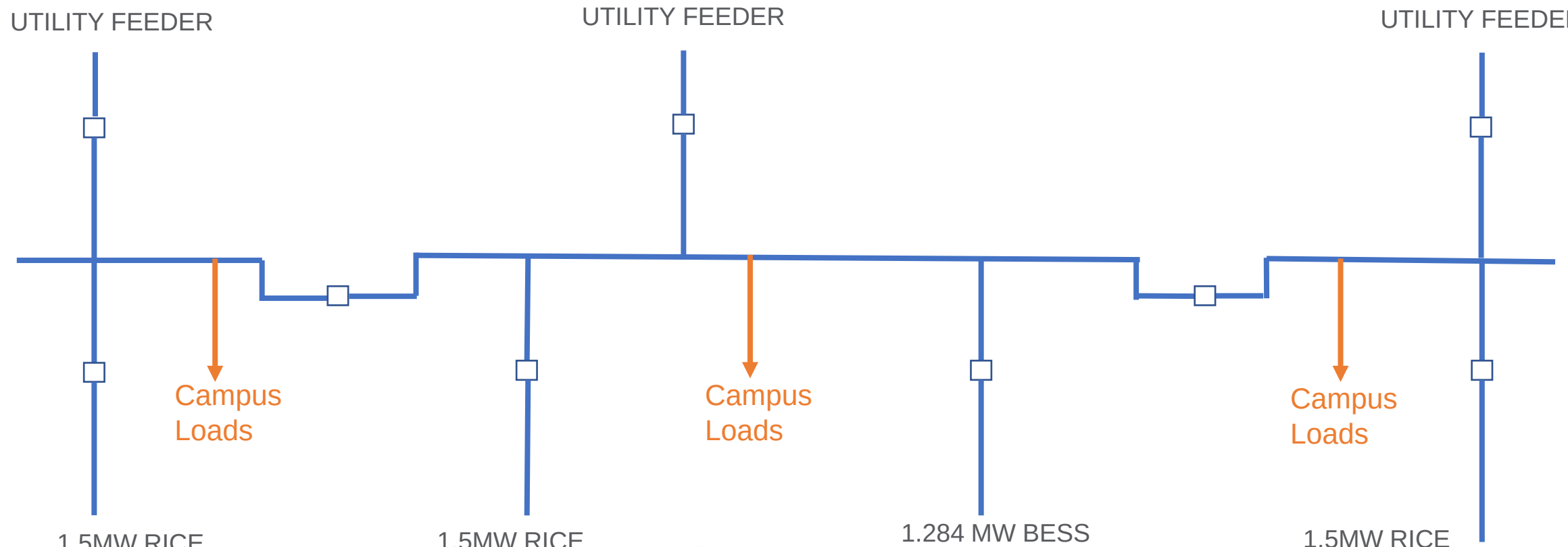
*Cooling Tons included in utilized HT loop thermal energy value.
**CCHP Efficiency (HHV) projected to achieve 73% upon maximizing chiller generation.

Microgrid Solution – Electrical Systems

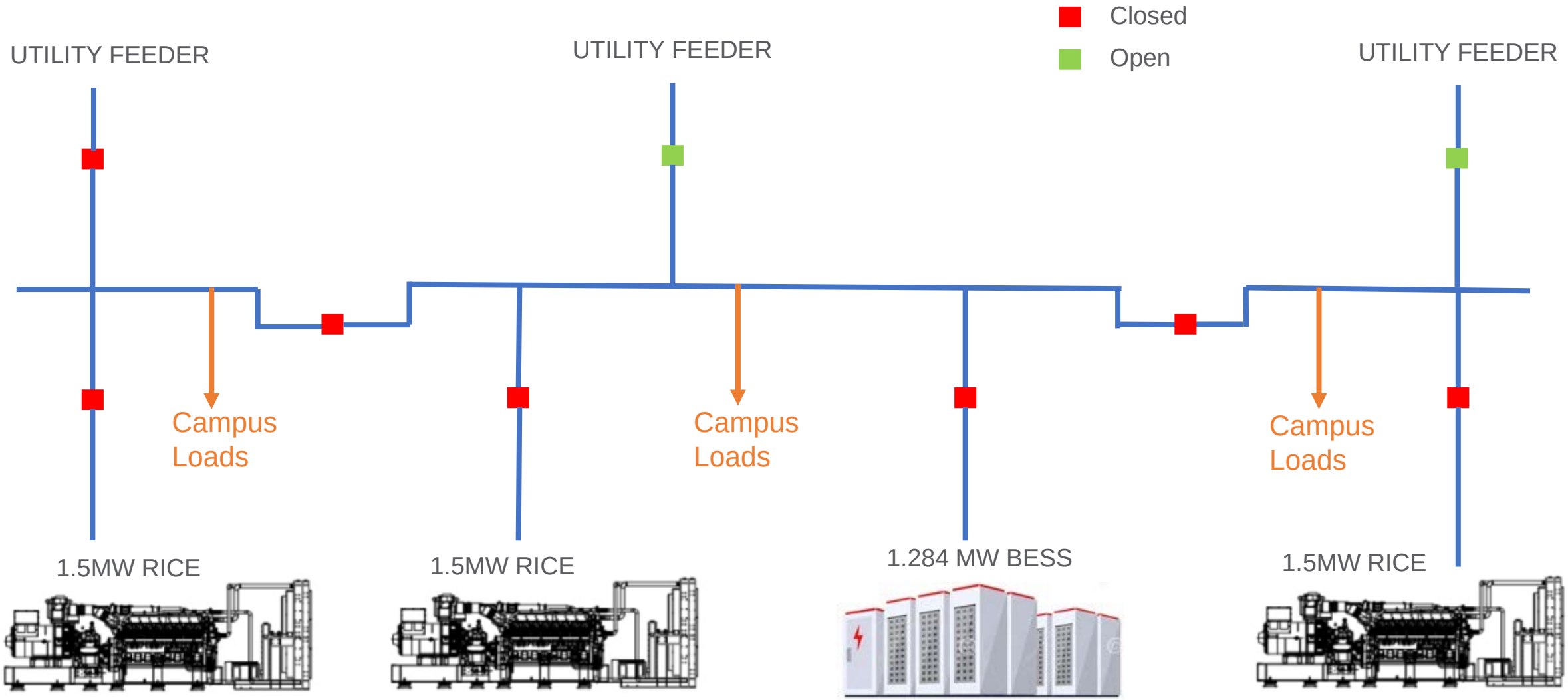
- 3 bus, 2 tie (M-T-M-T-M) configuration
- Campus Microgrid design includes gas generators, battery storage, community solar, and a microgrid controller
- Multiple operating modes including the ability to transition and operate in fully islanded mode



Campus Electrical Distribution System



Campus Electrical Distribution System (Normal Operation)



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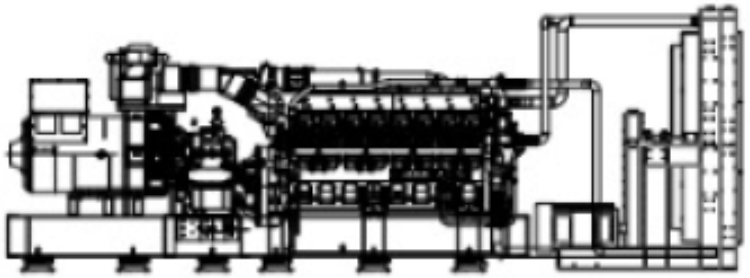
RICE (3 Units)

- 3 x 1.5MW Units
- At least 2 units are running during normal operation
- Units will provide base load capacity to the campus
- Generator protection will adhere to IEEE 1547 for interconnection to the grid



Battery Energy Storage System

- 1 x 1.284MW (2.5MWH) Unit
- Voltage/Frequency Regulation
- Provides instantaneous support in islanding situations
- Can act as an EDG in black start situations

Site Community Solar

- 12 buildings on campus installed with rooftop solar
- PVs are connected locally at each building
- All PV generation will be monitored, and the data sent back to the Microgrid Control Panel

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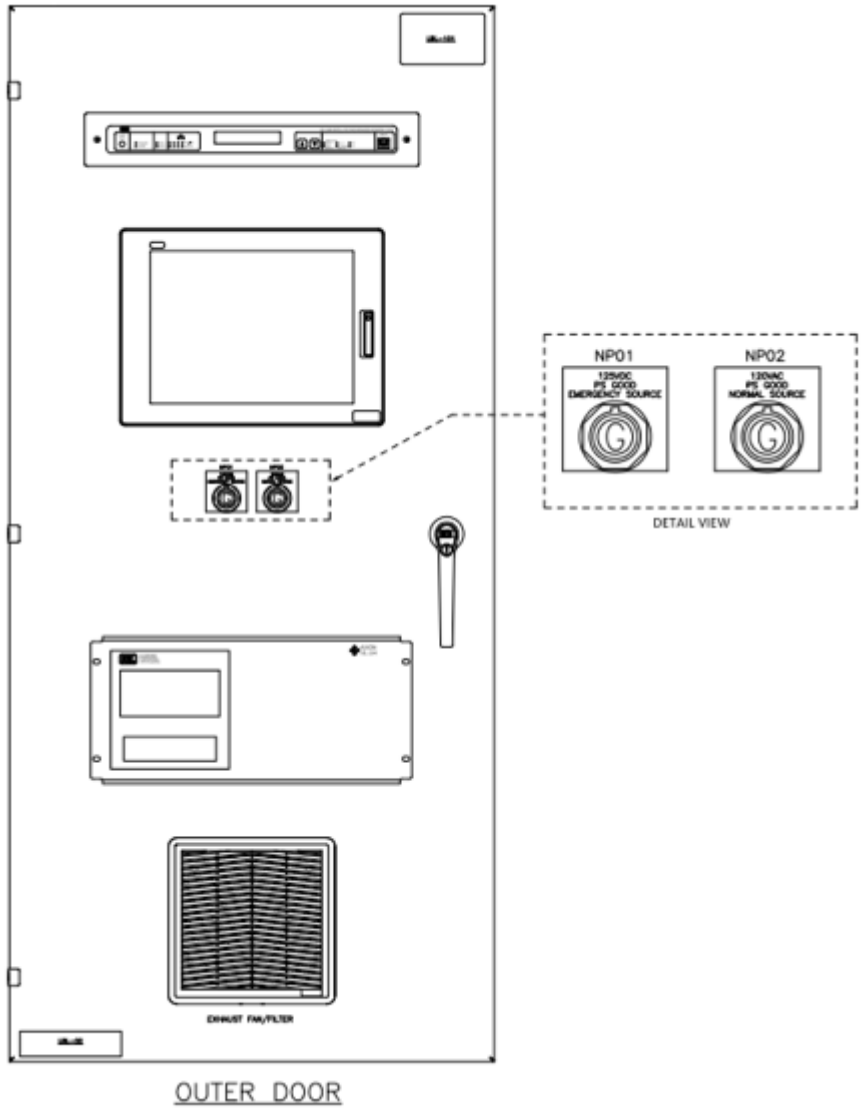
Microgrid Control Panel

- Brain of the Microgrid
- Monitors all on-site DERs and utility feeds to ensure that campus demand is met in most efficient and effective way possible
- Communicates with Utility equipment including initializing direct transfer trip (DTT)



Operating Modes

	Grid Parallel (Normal Operation)	Islanded Mode	Abnormal Mode	Utility Alone Mode (No Generation)
Utility Feeders	1 Utility Feeder in Service	No Utility Feeders in Service	1 or 2 Utility Feeders in Service	All 3 Utility Feeders in Service
Tie-Breakers	Both ties are closed	Both ties are closed	Either or both ties are closed (Utility feeders are never connected for >30 cycles)	Both ties are open
RICE	At least 2 units running	All 3 units running	At least 1 unit running	No units running
BESS	In service	In service	In service	Dependent on operating conditions

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Questions?

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Thank You!

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