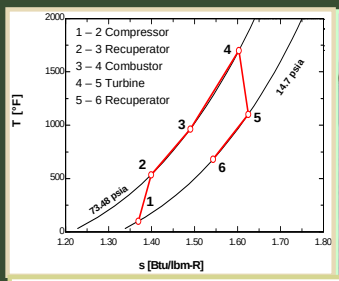
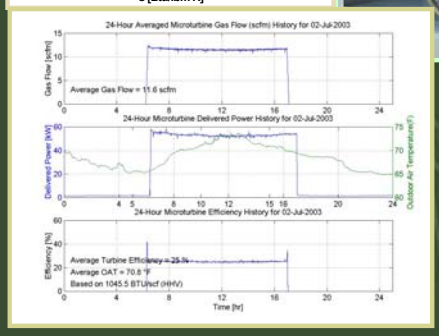
Microturbine CHP System at University of Maryland
Component Performance



DG/CHP Research at UMD

- CHP System performance measurements, maintenance and upgrade
- Steady state and transient modeling of microturbine, absorption chiller and solid desiccant
- 27 MW campus CHP plant modeling and optimization



Microturbine Advantage

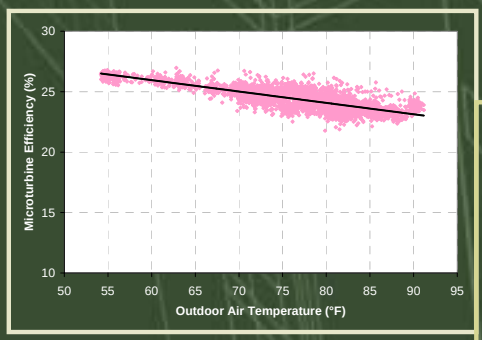
- Compact size and few moving parts
- Robust mechanical performance
- Free exhaust heat for downstream absorption chiller and desiccant system

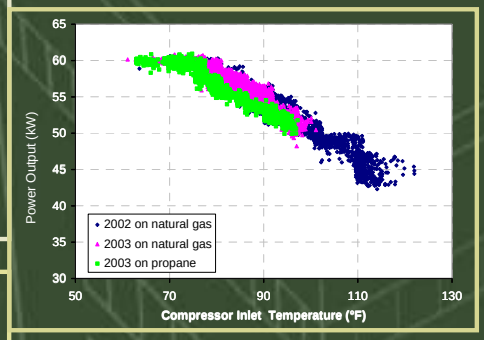
CHP System Operation on Natural Gas

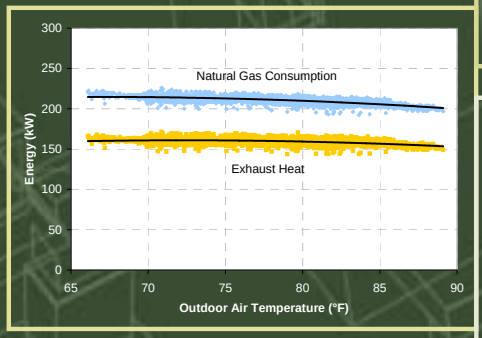
- Operated CHP System 2 on natural gas 35 hrs/week in Jun. ~ Aug. 2003
- Stable performance and easy operation – internet based start/stop control
- MT efficiency from 23~27% (HHV)
- NG consumption: 200~220 kW @ 60 kW demand
- Exhaust Emission: 150~160 kW @ 60 kW demand

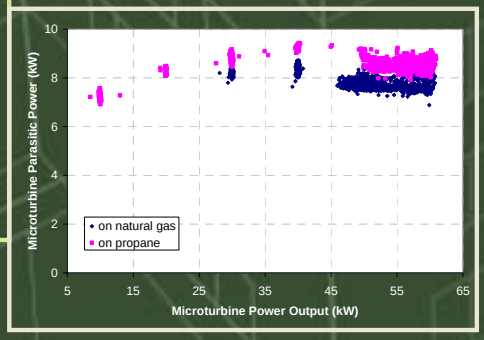
CHP System Fuel Flexibility

- Alternative fuels testing – propane replaced natural gas
- Operated microturbine on propane since fall, 8 hrs/day
- The change to propane demonstrates the fuel flexibility
- Raised the inlet pressure to the gas compressor to 10 psig
- Insulated gas pipe and installed heat trace to prevent condensation
- Parasitic power for propane is a slightly higher than that on natural gas





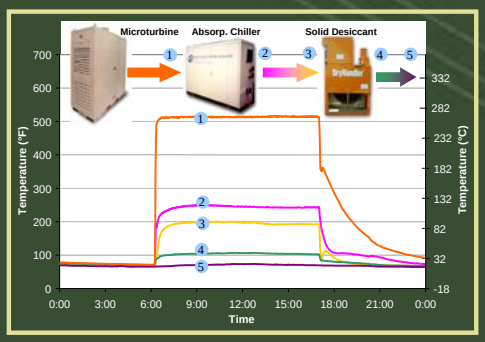




Center for Environmental Energy Engineering

CHP System Integration in 2003

Exhaust Temperature Profile of CHP System

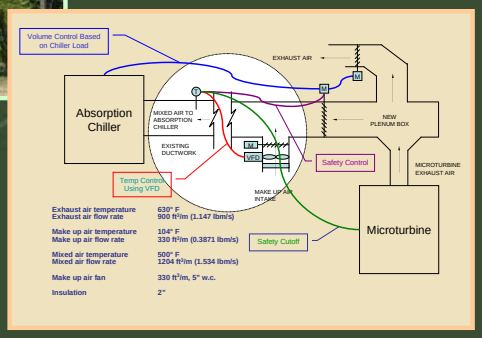


CHP System Integration

- Nominal output of CHP System 2: Microturbine - 60kW power, Absorption chiller - 20 tons cooling, Solid desiccant unit - 3000CFM dry air
- Effectiveness of Enthalpy wheel: 0.75 for Original Wheel, 0.84 for New Wheel
- Desiccant wheel: COP latent 0.55
- Absorption chiller: COP thermal 0.70

Absorption Chiller

- Controlled the exhaust inlet temperature to chiller by a VFD fan, which mixes the microturbine exhaust air and outdoor air
- Safety interlocks between the dampers and chiller to MT are designed and installed.
- Thermal COP and electrical COP are fairly constant regardless of the combined effect of weather, exhaust inlet temp. and chilled water supply temp. COP thermal = 0.70
- Mean chilled water supply temperature = 48°F
- Mean chilled water return temperature = 57°F
- Mean chilled water temp. difference = 9°F
- Mean chilled water flow rate = 47 gpm
- Mean Cooling Capacity ~ 18 tons.



Solid Desiccant Unit

- Effectiveness of Enthalpy wheel: 0.75 for Original Wheel, 0.84 for New Wheel
- Desiccant wheel: COP latent 0.55

Microturbine Integration Issues

- Exhaust heat buildup in custom micro turbine exhaust plenum caused performance degradation
- Redesign of plenum resolved issue
- Heat leak and conduction through the damper shaft deformed the damper actuator

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