UNIVERSITY of MARYLAND
UPPER CHESAPEAKE MEDICAL CENTER

MEMBER OF UPPER CHESAPEAKE HEALTH

The Benefits of Cogeneration:

A Case Study of Upper Chesapeake Medical Center

May 6, 2014

MD H2E
Hospitals for a Healthy Environment
MARYLAND

Upper Chesapeake Medical Center

- Located in Bel Air, Maryland, part of University of Maryland Medical System
- Contains a 200 bed state-of-the-art general medical, surgical hospital and medical complex including:
  - Hospital
  - Two medical office buildings (MOB) Pavilion I and II
  - Parking garage
  - Klein Ambulatory Care Center of Harford County
  - Administrative offices
  - Cancer Center
- Serves the residents of northeastern Maryland

University of Maryland Upper Chesapeake Medical Center
Campus Overview

Hospital Facility Challenges

- Single point of failure in backup power system design
  - One existing 1.5MW diesel generator
- Minimal to no upfront capital available for system upgrades
  - Capital budgets favored other revenue generating investments
  - Previous CHP capital budget requests denied
- Need for additional cooling capacity and backup power
- Limited space to install new CHP system components
- Increase electrical/steam/cooling/hot water availability during utility outages and emergencies
- Resources to oversee the design/construction/permitting and operation and maintenance of the CHP system

Electrical Distribution Hurdles

- Electrical service to the campus is delivered to a service station via a pair of 33KV feeders:
  - Fed to six (6) substations
  - Three (3) of the six (6) substations feed the “healthcare” uses
- Cancer Center is serviced by a separate feeder
- 1,500KW diesel generator insufficient to provide power to greater than the critical care and a few other connected loads

Solution Development

- Worked with ESF team to evaluate system sizing, location and options
- Considered various options including:
  - Two (2) smaller cogeneration totaling 2MW
  - Upsizing the absorption chiller
  - Increasing loads on existing electrical buses
- Derived optimal solution after considering:
  - Physical space
  - Total system cost
  - Seasonality of existing building loads
  - Thermal loads balance with electrical production
  - Noise mitigation to meet local ordinance db levels
  - Environmental impacts
  - BGE incentive requirements

UCMC CHP System Components

- 2 MW Caterpillar Natural Gas Reciprocating Engine
- 350 ton Broad Absorption Chiller
- 500 ton Heat Rejection Cooling Tower
- 2,245 lbs/hour Heat Recovery Steam Generator (HRSG)
- Two heat rejection radiators
- Two Plate and Frame Heat Exchangers
- Power Monitoring Control System (PMCS)
- Energy Management Control System (EMCS)

Other Key CHP Major Components

- Sump pump station
- Switchboard/circuit breakers
- Upgraded electrical breakers, panels and control systems
- Field devices:
  - Natural Gas meters
  - Heating & cooling system flow meters
  - Valves, actuators, temperature, and pressure sensors

2MW Natural Gas Fed Generator Set

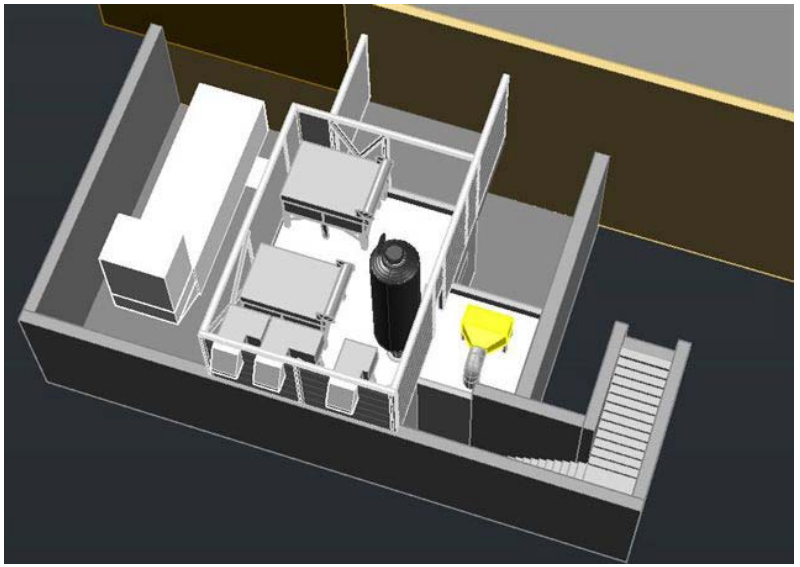
Chiller & HRSG Make Tri-Gen System

350 Ton Absorption Chiller

2,245 lbs/hour HRSG

System Layout

- The CHP is located within a single story, 705 sq ft building in existing mechanical pit
- The building houses:
  - Generator
  - HRSG
  - Feed water pumps
  - HT heat exchanger
  - LT and HT radiators
- Other components located in or adjacent to the existing central plant include:
  - Absorption chiller
  - Cooling tower
  - Electrical gear
  - Control panels



PPA Structure Highlights

- Hospital buys all electricity generated by system from ESF
- Byproduct of waste heat is “free” and used to calculate “effective price of power”
- Minimum monthly payments from hospital
- Minimum performance guarantees by ESF
- 20 year contract with fixed escalation, allows for budgeting of utility expense
- Operations and maintenance cost of system including all rebuilds incorporated into cost for 20 years
- Buy-out options for hospital to purchase system early
- Hospital supplies natural gas – cost of this embedded into economic analysis and savings

Rationale to Use PPA from Hospital Perspective

- Use of Federal tax credits and depreciation cannot access as non-profit hospital
- Ability to lock in future electric rates
- Access to funding source
- Ability to have turnkey delivery of all aspects system
  - Development
  - Permitting
  - Design
  - Construction
  - O&M
  - Financing
  - Incentive management
- Risk transference from hospital
- Complexity of project coordination
- Any cost overages borne by ESF

Some CHP and PPA Considerations

- Legal expense to negotiate PPA
- Town/County willingness to abate certain personal property tax
- Balance sheet treatment by auditors
- Potential of ongoing Title V compliance reporting costs
- Preparation for potential DHHS standards

Summary

- CHP system a “home run” for UCMC
- PPA structure facilitated delivery of vital infrastructure which would not have otherwise received funding
- Hospital able to operate during storm/prolonged outage
  - Improved reliability when combined with diesel generator (approximately 65% of hospital electrical load)
  - Serve as a vital community resource during emergencies
- Environmentally friendly solution
  - 2.0MW system equivalent of taking 2,200 cars permanently off our roads!