The Benefits of Cogeneration

Case Study: Upper Chesapeake Medical Center
Energy & Structured Finance

Development Group within Clark Construction Group

- Develops alternative energy systems
- Evaluates existing systems and recommend custom-designed, clean energy solutions across multiple technologies with recommendations that:
  - Address existing usage and growth potential at site
  - Are technology neutral
- Serves as developer/designer/contractor/financier/equity/owner/operations & maintenance provider of system
- Sells power to Client via long-term Power Purchase Agreements (PPAs) with equipment turnover options mid-term
Overview of Clark Construction Group

- 108 years of experience in building and civil construction
- One of the nation’s top healthcare builders
- Delivered nearly:
  - 27 Million sq ft of medical facilities
  - 10,000 Hospital beds
  - $9 Billion for healthcare projects
- Works in partnership with:
  - Private Healthcare Systems
  - Academic Medical Centers
  - Public Providers
Case Study For CHP: Upper Chesapeake Medical Center
Upper Chesapeake Medical Center

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
  - Parking garage
  - Klein Ambulatory Care Center
  - Administrative offices
  - Cancer Center
Campus Overview
Challenges Led UCMC to Consider CHP

- Single point of failure in backup power system design
  - One existing 1.5MW diesel generator
- Need for additional thermal capacity and backup power
- Limited space to install new CHP system components
- Concerns over prolonged hospital power outages after Hurricanes Sandy and Katrina led to depletion of diesel fuel
- Potential for new DHHS rule (Federal Register Vol. 78 No. 249) requiring hospitals provide emergency power to heating and cooling systems
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
Healthcare Operational Challenges

- Hospital functioning under all conditions
- Do no harm
- Ongoing operational management responsibilities
- Integration of new system
  - Complexity
  - Need to minimize shutdowns / system outages
UCMC Was Unable to Get Funding

- Limited capital available for system upgrades
  - Capital budget favored other revenue generating investments (e.g., MRI, CT-Scan)
  - Previous CHP capital budget requests denied

- Shortage of resources to oversee the design/construction/permitting and operation and maintenance of the CHP system
ESF owns, operated and maintains the system and sells power to the hospital
- Hospital purchase balance of power needs from Grid

ESF provided upfront capital for UCMC’s CHP system

20 year contract yet UCMC has the opportunity to buy out the system at a Fair Market Value early in life-cycle

Custom-designed CHP system provides hospital with electricity, heating, cooling and steam

In Island Mode system will serve 95% of hospital loads and 65% of campus loads
ESF Managed Delivery of UCMC CHP Project

Project Involved Multiple Disciplines and Risk

UCMC → ESF

FINANCE
- Lender

CONSTRUCTION
- Design/Engineering
- Construction Management

DEVELOPMENT
- Permits
- Utilities
- Deal Structure

TAX EQUITY

ON-GOING MANAGEMENT
- Fuel Source
- O&M
UCMC Benefited From CHP Delivery Via PPA

- PPA allowed hospital to avoid capital spend on system – paying for system largely through purchases of energy
- $1.5M in utility incentive funds used to substantially reduce the PPA rate
- Private ownership of system allowed non-profit hospital to benefit from key Federal Tax Programs
  - Investment Tax Credit at 10% of eligible basis
  - Bonus and accelerated depreciation
- Historically-low natural gas prices and significant domestic availability added to call to action
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
ESF Custom CHP Solution for UCMC

- ESF developed custom-designed solution for hospital:
  - 2.0 MW Cat recip engine; 350 T Broad Absorption Chiller; HRSG, Cooling Tower, Radiators

- UCMC System:
  - Generates electricity, steam, chilled water and hot water
  - Parallels the utility and provides baseload power
Chiller & HRSG Make Tri-Gen System

Absorption Chiller
(350 Ton)

Heat Recovery Steam Generator
(2,245 lbs/hour)
Broad Absorption Chiller Overview
Single Stage Absorption Cycle

\[ .78 = COP \]
Two Stage Absorption Cycle

1.4 = COP “Double Effect
Modern CCHP Systems

High Grade Heat Maximizes Cooling

Mode 1: Exhaust
- E&C: 113%
- E&H: 86%

Mode 2: Exhaust & direct-fire
- E&C: 113%
- E&H: 86%

Mode 3: Exhaust, hot water & direct-fire
- E&C: 104%
- E&H: 84%
Rapid Evolution of Technology

Over 25 years of R&D Evolution of Absorption chillers 10 models
Generation 11 will ship later this year!
Rapid Evolution of Technology

Multi Energy Absorption Delivers

- Smaller Mechanical Equipment Room
- Lowers cost to recover heat streams
- Simple sequence of operation
- Lower Maintenance costs
- Increases Up-time via higher reliability with less moving parts
Upper Chesapeake Medical Center
Project Results
Project operational since July 2014

UCMC avoided any upfront capital outlay for CHP through PPA structure
  – May choose to purchase system based on proven track record
  – Transferred performance, delivery, O&M and other risks to able third party
  – Facilities staff trained in operations and ready to take over system in future

UCMC will purchase balance of electricity for normal operations from utility and when CHP is offline
  – Provides 45% of the existing electricity for the main interconnected loads
  – Supplies more than 65% of campus electricity with existing diesel generator
  – Provides 95% of hospital loads with diesel when grid unavailable
  – Qualified for over $1.5M in Empower Maryland
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
Rational 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
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 campus and 95% 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!

Hospital projected to save over $9 million over 20 years (savings likely even greater as system operational 30-35 years with regular maintenance)
CHP System Today
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