Umass Memorial Medical Center, Worcester, MA
Combined Cooling, Heat and Power Project

Presented by:

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Agenda

• Introduction to UMass Memorial Medical Center
• Utility Usage
• Combined Cooling, Heat and Power Drivers
• Technical Highlights of Design
• Challenges / Lessons Learned
• Key Factors of Success
• Questions and Answers
UMass Memorial Medical Center - Worcester

- Opened in 1871 located in Worcester, MA
- Full service, tertiary care referral center
- Serves communities in Central and Western MA
- 319 beds
- Received multiple Hospital Quality and Clinical Quality awards within the past 12 months
- Central Utility Plant
  - Provides steam, hot water, and chilled water to many hospital areas / buildings
Central Utility Plant

• **Three Boilers**
  • Natural Gas with No. 2 Fuel oil backup
  • 700 HP – 24,150 lb/hr each
  • 120 psig, saturated

• **Three Chillers**
  • All centrifugal chillers
  • 2 x 1,000 Ton, 1 x 1,500 Ton

• **Two Cooling Towers**
  • Only have capacity to support existing chillers

• Natural Gas supplied by Eversource Energy

• Electric Utility is National Grid
• Summer Average – 2,540 kW; Peak – 3,825 kW
• Winter Average – 2,100 kW
Utility Usage

- Winter Average – 16,200 lb/hr; Peak – 23,900 lb/hr
- Summer Average – 8,500 lb/hr
• Summer Average – 935 Tons; Peak – 1,920 Tons
• Winter Average – 180 Tons
Utility Usage

Hot Water Loads – Heating and Domestic

South Basement (SB) Heating
East Penthouse (EP) Heating
East Basement (EB) Process
East Penthouse (EP) Domestic
South Basement (SB) Domestic
East Basement (EB) Domestic

Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Utility Usage

Hot Water Loads - Heating

- Winter Average – 3.6 MMBtu/hr; Peak – 5.2 MMBtu/hr
- Summer Average – 1.9 MMBtu/hr
Combined Cooling, Heat and Power Drivers

• Upgrades to patient and operating rooms result in changes to energy consumption patterns
• Increased sustainability and reliability
• Reduction in overall energy supply costs
• Increased utility plant operating flexibility
• Contribute to reduction in CO2 emissions
• Aging existing boilers and chillers
Highlights of CHP Design – Gas Engine Generator

- GE JMS 616, 2.7 MW engine
- Base-load operation, exporting excess power
- 13.8 kV generator
- Drop-over enclosure suitable for outdoor installation
- SCR mounted on enclosure roof
- Complete package with control system, lube oil cooler, jacket water cooler, inlet air ventilation, etc. all on a common baseplate
- Packaged with all auxiliaries by Northeast Energy Systems (Penn Power Group)
Highlights of CHP Design – HT & LT Water System

• HT system collects energy from lube oil, jacket water, 1st stage intercooler, and engine exhaust
• LT system rejects energy from 2nd stage intercooler
• HT Water System
  • 6.2 MMBtu/hr – 280 gpm, 200 °F – normal operation
  • 8.3 MMBtu/hr – 280 gpm, 216 °F – without steam
• Delivers hot water to building heating, condensate preheating, and a new hot water absorption chiller
• Independent full heat rejection radiators
Highlights of CHP Design – HRSG

- Cain low-volume coil-tube unit
- Complete packaged and pre-assembled unit with circulating pump, economizer, feedwater controls, instrumentation and control panel
- Steam production – 2,700 lb/hr, 130 psig, sat.
- Bypass damper controls steam pressure and allows operation of gas engine without HRSG steam production
- HT water energy increased if HRSG bypassed
Highlights of CHP Design – Absorption Chiller

- Thermax single effect, low temp. hot water chiller
- 360 Ton capacity, 865 gpm at 44°F
- Located within the existing boiler house
- Steam Heat Exchanger augments HT water energy to boost chiller production when needed
- New cooling tower dedicated to new chiller
- Siemens control system controls the chiller and the steam heat exchanger to optimize production
- Controls are tied into the existing BMS to operate in parallel with existing chillers
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Highlights of Design – Electrical

• 13.8 kV switchgear for engine and utility breakers as well as metering, located outside
• MCCs located in existing electrical room for engine and balance of plant equipment
• Engine operates in parallel with the local utility, but can also island from the utility and black start
• DIA.NE engine and auxiliaries control panel located in existing electrical room
• Plant Control System
• Siemens control system for chiller and building heating loops.
Challenges / Lessons Learned

- Interfacing with electrical utility provider
- Engagement with natural gas supplier
- Ensuring all stakeholder interests are met
- Construction in a constrained area and operating plant and fitting all of the equipment into the space
- Construction schedule
- Clear understanding of design intent – hot water only or hot water and steam
Key Factors of Success

- Performing a detailed feasibility study to get Stakeholder buy-in
- Sufficient schematic design phase allowing details of equipment supply to be determined
- Conducting laser scan of existing plant and preparing an overall 3D model
- Data logging of hospital hot water loads
- Early purchase of major equipment
- Design / Build project execution using Cogeneration Power Technologies
- Incentives available for CHP projects
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Thank you