V.I.P. Country Club CHP Facility

Microturbine CHP with
Space Heating and Cooling

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V.I.P. Country Club CHP Facility

Project Objectives

• Design and install a CHP system for a medium sized business that achieves an overall efficiency of 70% to 80% which significantly exceeds the efficiency of current electric power plants (approximately 33%)
• Reduce the total cost of Natural Gas and Electricity Bills
• Achieve a 5 year payback period
• Improve the reliability and quality of electric power for the customer
• Design and install computer control system (customer perception) for automated operation
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Electric Power Generation

• Three 60 KW Capstone Microturbines
• Natural Gas Fired (804,000 BTU/hr per Microturbine)
• Efficiency = 28 ± 2%
• Features:
  Grid Parallel
  Compliance with UL 1741 (Inverters, Converters and Controllers for use in Independent Power Systems)
  Stand Alone (with Automatic Transition from Grid Parallel Mode)
  Load Following
  Auto-Startup and Auto-Shutdown
  Remote Monitoring and Control through Modem and Serial Port
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Capstone Microturbines and Copeland Natural Gas Compressors
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Heat Recovery

- Three custom designed Stainless Steel Heat Recovery Units
- Heat Recovered from Exhaust Gas is used to generate Hot Water
- Provides Building Heating and the Thermal Energy Required to Operate Three 20 Ton Lithium Bromide Absorption Chillers for Building Cooling
- Generates 1,070,000 BTU/hr
- Maximum Water Outlet Temperature = 210 Deg F (measured)
- Programmable Heat Exchanger Bypass Door
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Three Heat Recovery Units
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Chilled Water Production

- Three Yazaki 20 Ton Hot Water Fired Lithium Bromide Absorption Chillers
- 48 Deg F Chilled Water is produced from Hot Water generated by Heat Recovery Units
- Three Water Circuits:
  - Heat Medium Water must be kept above 152 Deg F (7½ HP Pump)
  - Chilled Water must be kept above 38 Deg F (7½ HP Pump)
  - Cooling Tower Water must be kept above 75 Deg F (10 HP Pump)
- Chiller Control System provides Run/Stop Signal to Pump VFD
- Electric Power required for pump operation = 23 KW (approximately)
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Three 20 Ton Yazaki Absorption Chillers
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CHP Control System

- Controls all CHP subsystems (microturbines, heat recovery unit, absorption chillers and pumps)
- Retrofit standard Desktop Computer with Data Acquisition and Control Boards
- Agilent VeePro Software with Graphical User Interface (GUI)
- Thermocouples for Water and Exhaust Gas Temp Measurement
- Transducers for Pump Discharge Pressure Measurement
- Variable Frequency Drives for Pump Control
- Electrically Actuated Valves for seasonal changes (Honeywell)
- Receives Run/Stop signal from Master Microturbine
- Receives Grid Connect/Stand Alone signal from Capstone Dual Mode Controller (DMC)
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Relay Protection

• Capstone Microturbines have UL Listed Protective Features for Voltage, Frequency, and Current
• The electric grid area managed by Consolidated Edison of New York requires compliance with Relay Protection described in Specification EO-2115
• Required Equipment includes:
  Intertie Breaker
  General Relay Protection for Voltage, Frequency and Current
  Three-Phase Reverse Power Protection
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600 Amp Capstone DMC Equipped Shunt Trip Intertie Breaker
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ABB Alpha Plus Power Meter and Protective Relay Control Panel
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Capstone Remote Monitoring Software (Display Shows 143 KW)
Results and Projections

• CHP System efficiencies are approximately 70% during Heating and Cooling Seasons
• Projections and initial system performance indicate that the Demand Change during the Cooling Season will be reduced by approximately 250 KW
• Backup Electric Power is available (very important for this facility)
• Power Quality improvement? Difficult to determine thus far
• Payback Period is projected to be approximately 5 years (this value includes 50% co-funding provided by NYSERDA
• In general, the “hands-off” capability provided by the control system appears to be satisfied