



Experience with Broad Chiller Using Microturbine Exhaust

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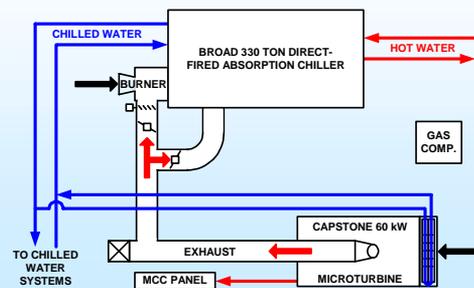
PROJECT ORGANIZATION

- Project Manager - Henry Mak
- Construction Manager - Steven Yip
- Facilities Operations Manager - Shawn Johnson
- System Performance Monitoring Manager - Rod Schwedler
- Funding Partners - SoCal Gas, Sempra Energy, Department of Energy and Broad USA



PROJECT SCHEDULE

Equipment Delivery	Plan	Actual
• Absorption Chiller	Sep/01	Nov/01
• MicroTurbine	Jul/01	Dec/01
System Commissioning		
• Absorption Chiller System	Nov/01	Mar/02
• MicroTurbine	Nov/01	Dec/01
Monitoring Underway	Jan/02	May/02



CENTRAL ENERGY PLANT

- Four buildings combined into a central energy system for both cooling and heating
- Major Equipment Added
 - 1 - 330 RT Broad double-effect chiller/heater
 - 1 - Capstone C60 Microturbine
- Major Equipment Removed or Moth-balled
 - 2 - Steam fired absorption chillers
 - 1 - Steam Boiler





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BUDGET

- When originally conceived, the project was expected to cost approximately \$800,000
- Subsequent integration of the BCHP and planned facility improvements (the Central Energy Plant - CEP) increased the project cost to \$1.8MM

7



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COST BREAKDOWN

	<u>Actual</u>
• MicroTurbine	\$ 65,000
• Chiller & Ancillary Equip	365,000
• Equipment Installation (inc piping)	400,000
• Site Preparation	120,000
• Building	570,000
• Architectural/Engineering	240,000
• Project Management	<u>40,000</u>
• TOTAL	1,800,000

8



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MICROTURBINE SELECTION

- Chiller and Parallon MTG was configured and tested at Broad Factory
- Parallon MTG was performance tested for 6 weeks at SoCal Gas before Honeywell recall
- Capstone C60 selected as replacement unit, causing several months delay
- Redesign Issues
- Inlet air cooling system for the MTG was included

9



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CHILLER SYSTEM SELECTIONS

- Broad 330 ton DFA chiller/heater
- Power Flame Ultra Low Emission Burner
- Marley 500 ton, 1500 gpm cooling tower
- 800 gpm chilled water flow
- Integration with several existing chilled water systems
- Replaced one Freon system

10



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PERMIT ISSUES

- Air Quality permit from SCAQMD 4 months
- Local Agency Permits 6 weeks
- Interconnect existing agreement

11



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STARTUP ISSUES

- Microturbine
 - Power module filters failed on the first attempted startup sequences
 - Power monitor unit in the MCC was destroyed
 - Software problem corrected and unit was commissioned
 - One week delay

12



STARTUP ISSUES

- Chiller
 - Water system design problems
 - Chiller control problems
- Integrated System
 - Dampers
 - Controls

13



OPERATING RESULTS

- Microturbine Electrical
 - 8100 Hours (Virtually full load, 56-59 kW)
 - 27-28% Electrical Efficiency (ISO)
 - Parasitic Losses - 8kW from DC bus to MCC panel
- Microturbine Heat Recovery
 - 100,000-200,000 Btu/hr (only when chiller burner is on)
 - ± 70% System Peak Efficiency

14



OPERATING RESULTS

- Microturbine Other
 - Nox Emissions < 9 ppm
 - Reliability
 - Several weeks downtime (ongoing fuel system faults after 8000 hours)
 - Noise within Capstone specs (This C60 has insulated inlet air and exhaust ducts)

15



OPERATING RESULTS

- Chiller/Heater
 - Cooling COP up to and slightly over 1.0, depending on load
 - Heating Efficiency Not enough data, low load
 - Reliability
 - Numerous short outages, 1 - two week outage
 - Parts Availability was a major issue
 - NOx Emissions 40-60 ppm

16



SUPPLIER SUPPORT (Capstone)

- Sales
- Commissioning
- Technical
- Spare Parts
- Warranty Issues

17



SUPPLIER SUPPORT (Broad)

- Sales
- Commissioning
- Technical
- Spare Parts
- Warranty Issues

18



GENERAL EXPERIENCE

- What could be done better
 - Need to stay more focused on the core project
 - Be sure to get involved in the design process
 - Vendor selection is critical
 - Packaging and insulation design

19



ONGOING WORK

- Chiller Burner development
- Integrated Systems Control
- Duct changes
- Additional Microturbines

20