Overview of Cogeneration Facility

Mark Johnson
Plant Manager
Clearway Energy Inc.
Pittsburgh, PA
- Founded in 1878
- 50 acre campus
- Approx. 4 million total building square footage
Energy Center History

• Duquesne signed an agreement with NORESCO, after facing several challenges:
  • Aging equipment
  • Environmental issues
  • Rising Energy costs
• The partnership with NORESCO addressed these by developing the Energy Center and using the most advanced technology.
Energy Center History – Cont.

• Duquesne University and NORESCO entered into a 15 year contract Feb. 1996
• Began Operations November 1st, 1997
• Project cost was approximately $9.6 million with NORESCO financing $4.5 million over the life of the contract
Relationship With Local Utilities

• At the time, Duquesne Light Co. had no independent customer energy generation. This concept was fairly new to them.
• Much effort went into the process from start to finish.
• The University had to adhere to interconnection regulations.
• Led to creation of Rider 16 which is back up power supply to non-utility generators.
• Relationship over time has improved and led to adjustment of Rider 16 in 2014.
Energy Center New Equipment

- 5MW Solar Taurus 60 natural gas fired turbine
- 25,000 lb./hr. waste heat boiler (125 psi)
- Natural gas compressor 15 to 235 psi
- Condensate receiver and boiler feed water system for new and existing boilers
- Utility electric interconnect breaker/relay system
- Existing electric system upgrade
- Electronic control package for cogen and existing boilers
Energy Center New Equipment – cont.

- Two (2) 750 ton 2 stage absorption chiller
- One (1) 1000 ton 2 stage absorption chiller
- Approx. 4,000 feet of 18 inch to 6 inch chilled water campus supply and return distribution piping and controls
- Two (2) 150 HP chilled water pumps
- Two (2) 250 HP condenser water pumps
- Four (4) cooling tower cells to handle 2,500 tons
- Internal plant chilled water and condenser water piping and controls
- Complete electric and control system
Basic Combined Heat & Power
ECP Uptown Campus LLC
Gas Turbine
Gas Turbine
Natural Gas Boiler
Natural Gas Boiler
Electric Distribution System
Duquesne Light
## How do Others Compare?

<table>
<thead>
<tr>
<th>School</th>
<th>Year Completed</th>
<th>Total Carbon Footprint</th>
<th>Carbon Footprint/Student</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duquesne University</td>
<td>2012</td>
<td>39,203</td>
<td>3.92</td>
<td>Pittsburgh, PA</td>
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<tr>
<td>Temple University</td>
<td>2012</td>
<td>189,983</td>
<td>5.9</td>
<td>Philadelphia, PA</td>
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<td>Xavier University</td>
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<td>Cincinnati, OH</td>
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<td>University of Massachusetts-Amherst</td>
<td>2012</td>
<td>138,146</td>
<td>4.9</td>
<td>Amherst, MA</td>
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</tbody>
</table>
Average Annual Performance

- Generator produced - 32,382,044 Kwh (86%)
- Imported from DLCO – 5,149,038 Kwh (14%)
- Turbine availability – 8,533 hours (97.5%)
- Waste heat boiler produced – 157,344 MLB (74%)
- Gas boilers produced – 56,617 MLB (26%)
- Gas turbine used – 406,766 MCF of natural gas
- Boilers used – 68,481 MCF of natural gas
- Energy center used – 14,430,034 Gal. of water
Design Scheme

- Generator to run in parallel with Duquesne Light.
- Not intended to furnish all electric.
- Design to utilize all waste heat all the time.
- Waste heat to drive absorption chillers in summer and heat campus in winter.
- Can run isolated if load is reduced.
- No black start.
- Automatic load shedding.
2009 ENERGY STAR® AWARD
COMBINED HEAT AND POWER

Presented to
Duquesne University

By the United States Environmental Protection Agency and the United States Department of Energy in recognition of the significant pollution reduction and energy efficiency qualities of the Duquesne University Energy Center.

Awarded on June 29, 2009

Kathleen Hogan
Director, Climate Protection Partnerships Division
U.S. Environmental Protection Agency
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Why we selected Ice Storage

• Added 6000 ton/hr capacity without adding cooling towers
• Utilizes off peak electric rates
• No change in condenser loop piping
• More efficient utilization of existing equipment
28 Storage Tanks – 6000 ton hrs
Chilled Water/Ice System
Questions?