Case Study – Executing a 200 kW Combined Heat and Power Project

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Case Study Overview

- Project Summary
- Combined Heat and Power (CHP) Background
- Concept Development
- CHP Development Resources
- Project Timeline
- Project Site
- System Design
- Construction
- Completed System
- Project Takeaway
- Questions
Project Summary

- 6 Cylinder 1800 RPM Natural gas reciprocating engine
- Energy Input 2,100,000 Btu/hour
- Electrical Output 200 kW
- Usable hot water output 1,000,000 Btu/hour
- Installed at manufacturing facility in Cincinnati, Ohio
- Projected 4 year payback
Efficiency Advantage of CHP

SEPARATE HEAT AND POWER PRODUCTION

170 Units Fuel

50% ENERGY EFFICIENCY

COMBINED HEAT AND POWER (CHP) / COGENERATION

Results in 85 Units of Useful Energy

100 Units Fuel

85% ENERGY EFFICIENCY
Typical CHP System Flow
• DSIRE – Database of State Incentives for Renewables and Efficiency – www.dsireusa.org
• EPA Combined Heat and Power Partnership – www.epa.gov/chp
• USDOE Southeast CHP Technical Assistance Partnership – www.southeastchptap.rlmartin.com
Project Timeline

October 2012 – Developed CHP Project Concept
November 2012 – Presented Concept to Executives
December 2012 – Received approval to proceed with facility energy audit
March 2013 – Completed energy audit supports 210 kW CHP System – Project funding approved
April 2013 – Located and acquired packaged CHP unit – began final design, permitting and utility interconnection processes
May 2013 – Located and acquired auxiliary equipment
June 2013 – Completed design, obtained building permit, started construction
July 2013 – Completed interconnection agreement, completed civil construction
August 2013 – Received air permit, completed mechanical construction
September 2013 – Completed electrical construction and System Commissioning
December 2013 – Ribbon cutting event with proclamation from Ohio Governor
System Design – Electric Load
System Design – Thermal Load

- Acid Passivation Process in Plant
- 1,000,000 Btu water heater used to maintain tank temperature.
Project ROI

• Facility Electric Cost - $0.095/kWh
• Facility Gas Cost - $5.00 / MMBtu
• Minimum Electrical Requirement – 200 KW/h
• Thermal Demand – 1,000,000 Btu/h
• Annual Operating Hours – 8,000+ hrs
• Project Installed Cost - $300,000
• Simple Payback – 4 yrs
## CHP Unit Specifications

<table>
<thead>
<tr>
<th>GridFox 210 Technical Information</th>
<th>GridFox 210 Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit Weight</td>
<td>16,060 lbs</td>
</tr>
<tr>
<td>Engine</td>
<td>Liebherr TBG 926</td>
</tr>
<tr>
<td>Generator</td>
<td>Stamford HC 434 E</td>
</tr>
<tr>
<td>Speed</td>
<td>1800 rpm</td>
</tr>
<tr>
<td>Fuel</td>
<td>Natural Gas</td>
</tr>
<tr>
<td>Voltage / Frequency</td>
<td>480 volts / 60 hz</td>
</tr>
<tr>
<td>Electric Power 100% Load</td>
<td>210 kW / 252 kVA</td>
</tr>
<tr>
<td>Energy Input 100% Load</td>
<td>2,100,000 Btu/hr</td>
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<tr>
<td>Engine Power 100% Load</td>
<td>295 bhp</td>
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<tr>
<td>Hot water out Temperature</td>
<td>185 Deg. F</td>
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<tr>
<td>Usable Hot Water Thermal Output</td>
<td>1,100,000 Btu/hr</td>
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<tr>
<td>Hot water return Temperature</td>
<td>158 Deg. F</td>
</tr>
<tr>
<td>Exhaust Gas Temperature</td>
<td>248 Deg. F</td>
</tr>
<tr>
<td>Inlet Gas Pressure</td>
<td>0.29 - 0.725 psi</td>
</tr>
</tbody>
</table>
Equipment - Auxiliary
Equipment - Auxiliary
Project Construction – Cont.
Completed System
Completed System – Cont.
Project Takeaways

- Size the CHP system to match the heating load
- Do not base project economics on selling electricity back to the utility unless there are attractive net metering tariffs
- The CHP project team needs to understand electric supply contracts, gas supply contracts, utility interconnection, air permitting, local permitting, available incentives, project financing, project economics, PLC control systems, civil, mechanical and electrical design and construction
- Be prepared to educate internal and external stakeholders about CHP benefits and limitations
- Verify existing contracts for electricity allow CHP installation
- Start the interconnection design and application process as soon as possible
Questions?

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