Capstone MicroTurbine for the Oil and Gas Industry

Blake Zimmerman
Pumps & Service
2011
What is a MicroTurbine?

Power generator driven by a small scale gas turbine

- Electrical Efficiency of 26-33%
- CHP can achieve thermal efficiency of 80%+
- Wide range of fuels – 350 btu to 2500 btu
  - Up to 7% H₂S with C30
- Extremely Low Emissions
- Air Bearings
- Air Cooled
- Dry Engine
- Variable Speed
  - 45,000 to 96,000 RPM
- Proven reliability
  - >25 million hours of operation

© 2008 Capstone Turbine Corporation • www.capstoneturbine.com
Within 5 rotations of the shaft, we accelerate to around 20,000 RPM. This achieves lift off. A boundary layer of air will form between the foils and the shaft. This layer of air will effectively lift the foils up and away from the shaft. The springs provide counterforce to the foils and air, effectively keeping the shaft centered on its cushion of air. After lift-off there is no metal-metal contact in the bearing, hence no friction and no wear.
Inside the Capstone MicroTurbine

- No gearbox, pumps, or other mechanical components
- Recuperated Engine
  - All welded design
  - Fabricated by Capstone
- Permanent magnet alternator
- Lean premix combustion
Key Components (C65)

- Air Inlet Filter
- Generator
- MicroTurbine Engine
- Battery Control Module
- Fuel Control System
- Battery Pack
- Load Control Module
Capstone Products

Available with gas & liquid fuels

C30 & C65

C65 CHP

C200 & C200 CHP
C600/C800/C1000 Series

- 3, 4, or 5 of the C200 series turbine are installed in a 30 foot enclosure for 600kW, 800kW, or 1,000kW output
Capstone Products

C30 & C65
Class I Div 2
ATEX Zone 2

C30 & C65 SS

© 2008 Capstone Turbine Corporation • www.capstoneturbine.com
# Maintenance

<table>
<thead>
<tr>
<th>Hours</th>
<th>Task</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>8,000</td>
<td>Air Filters</td>
<td>Clean/Replace</td>
</tr>
<tr>
<td>4,000 for C1000</td>
<td>Fuel Filter</td>
<td>Replace</td>
</tr>
<tr>
<td>20,000</td>
<td>Igniter</td>
<td>Replace</td>
</tr>
<tr>
<td>20,000</td>
<td>Injectors</td>
<td>Replace</td>
</tr>
<tr>
<td>40,000</td>
<td>Battery Pack</td>
<td>Replace</td>
</tr>
<tr>
<td>40,000</td>
<td>Thermocouple</td>
<td>Replace</td>
</tr>
<tr>
<td>40,000</td>
<td>Engine &amp; Generator</td>
<td>Exchange</td>
</tr>
</tbody>
</table>

- Typical Maintenance cost of $0.003 kWh vs. $0.015 for Recips
- Average of 6 Hours of Planned Maintenance per year
- Factory Protection Plan

*Inspecting unit at 20,000 hrs on an offshore platform*
Ultra Low Emissions

Capstone C1000 vs. Jenbacher JMC320 Emissions

- Much Lower Emissions Than Traditional NG Reciprocating Engines
Benefits of MicroTurbines in O&G

- Low Maintenance
- Lower Total Cost of Ownership
- Short Commissioning Period
- Easy Interconnects to Local Grid or Bus
- Ease of Operations
- No Lubricants or Coolants
- Small Footprint, Light Weight
- < 65dBA Acoustic Emissions
- Ultra-low emissions with no post-combustion devices or chemicals
- Accepts 350-2500 Btu w/up to 7% H₂S (C30)

2 C65’s as prime power for LACT unit
Exhaust Heat Utilization - CHP

- Heat to glycol or hot oil systems
- Preheat fuel gas to larger turbines
- Preheat water to steam boilers
- Direct heat to oil/water separators
- Additional heat to regas LNG
- Building or utility heat
- Amine plant applications

Heat from two C30s running on untreated wellhead gas goes to “heattreater” separator
Oil & Gas in North America

- EagleFord Shale
- San Juan Basin
- Haynesville Shale
- Marcellus Shale
- Barnett Shale
- Bakken Shale
- North Slope Alaska
- Canada
- Fayetteville Shale
- Jonah Field
- Piceance Basin
- Permian Basin

- More than 70 O&G customers worldwide
- Over 80 packages installed offshore

~ 80% of all Microturbines Sold Worldwide are Capstone
Points of Contact

• Blake Zimmerman
  Corporate Account Manager- Oil and Gas – TX, OK, AR
  Houston, TX
  Cell 713-679-3222
  blakez@pumpsandservice.com

• Corporate Office
  Pumps and Service
  603 South Carlton
  Farmington, NM  87401
  505-327-6138
  www.pumpsandservice.com
  www.capstoneturbine.com