Brea Power Project

Gas Processing Experiences
Executive Summary

• The Olinda-Alpha Landfill Gas to Electricity Generation Project (“Project”):
  – State-of-the-art combined cycle generating facility that became operational in late 2012.
    • 4 Solar Gas Turbines, 1 Steam Turbine (4 x 1 configuration)
    • 3 Cooper Recip Engines, 1980’s vintage machines with upgraded combustion
  – Project has been under development since 2006
  – Achieved Commercial Operation in November, 2012
  – Currently the 3rd largest landfill gas (LFG) fueled power plant in the country.
  – Envisioned to lead this sector of LFG to energy in both high efficiency and low emissions
  – Envisioned to be an example of the goals and purpose of the U.S. EPA’s Landfill Methane Outreach Program.

“Creativity is thinking up new things. Innovation is doing new things.”
-- Theodore Levitt
Energy Production

- At FULL rated capabilities
  - The New Project generates up to 32.5 MW of low cost renewable energy
  - Internal energy consumed to produce output is about 5 MW
  - With the existing facilities at the site can produce 37.5 MW.
  - *Environmental Emissions assured based on SCR technology*

- Roughly ten times the size of the average LFG to electricity project
  - Clearly implies added gas treatment challenges and equipment

Gas Treatment

- Nominal Gas Treatment Description & Process:
  - 3 vessels/treatment train. 2 trains. One in service, one in regeneration at all times
  - Upstream knock outs and particulate filters
  - Downstream Carbon Polishing beds & a particulate filter
  - Treated Gas Conditions:
    - 9,800 – 11,000 SCFM @ 50% CH4, 100 psig, 100°F
    - Treatment Rate: >100 SCFM/sq ft of media available
Performance Expectations and Results

- At the stated design operating conditions the system is expected to achieve:
  - 99.94% or better removal efficiency on a continuous basis

- Through extensive testing, redesign and operations:
  - Media 1 Concept: Three media scheme (Mole Sieve, Activated Alumina & Silica Gel)
  - Media 2 Concept: All media in column as Silica Gel
  - Results of gas cleanup do not meet required specifications
  - Most Recent sample results:

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<th>LAB Reference</th>
<th>Sampling Date</th>
<th>Siloxanes mg/m³</th>
<th>Silicon Si Equivalent mg/m³</th>
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<th>Treatment Efficiency % Silicon</th>
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Approximately 45 X beyond SCR control spec
Performance Expectations and Results

- Historical Trends: Train “A” using 3 Blend media column:
  - Maximum Limits for Turbine and SCR shown by RED dashed line(s)

![Graph showing historical trends of Train A's performance.](image-url)
Performance Expectations and Results

- Historical Trends: Train “B” using Single media column:
  - Maximum Limits for Turbine and SCR shown by RED dashed line(s)
**What’s Next:**

– Testing all new media and SCR Catalyst since September
– Initial siloxane removal performance approximating previous tests
– Efforts continue, with limited success, to increase regeneration temperatures from 425°F to 475°F

**Longer Term:**

– Gas clean up technology continues to be more R&D than repeatable operations
– Even under stable & near new media conditions the SCR technical limits are exceeded
– Operating life cycle of the media and catalyst are dramatically less than forecasted primarily due to heavy siloxane loading on the catalyst
– Economic and technical conflicts will require rethinking of the technology or permitting constraints

Approximately 45 X beyond SCR control spec
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