Maricopa Association of Governments
Greening Water and Wastewater Infrastructure Workshop

Green Energy Utilization of
91st Ave WWTP Digester Gas

January 12, 2010
Previous SROG Studies

- 1995 Digester Gas Utilization Study
- 2004 Digester Gas Scrubbing System Evaluation
- 2008 Bio-solids Management Study
91st Ave WWTP

- 140 MGD 2009 Avg Daily Flow
- Primary Treatment
- Conventional Activated Sludge
- Anaerobic Digestion
Typical WWTP Solids Schematic:
Unit Solids Balance, Gas Generation and Available Energy for 1 mgd WWTP Capacity

- 15 cf gas/ # VSS destroyed
  - = 16,000 cf/ Mgal treated
  - = 600 Btu/ cf
  - = 9.5 MBtu/ da/ mgd
  - = 30 kw

1 mgd

Primary Clarifiers
1,500 #/da/mgd @ 80% Volatile

Final Clarifiers
1,200 #/da/mgd @ 78% Volatile

Thickener
2,700 #/da/mgd @ 79% Volatile

Anaerobic Digesters
1,100 #/da/mgd destroyed

Biogas
1,600 #/da/mgd @ 65% Volatile

Dewater

0.8 t dry solids/da/mgd
= 3.2 t wet solids/da/mgd @ $20 - $50/t wet solids
= $23k - $58k/ yr/ mgd
91st Ave Solids Treatment

- 16 Anaerobic Digesters
- 317,000 Pounds/day Primary Solids
- 117,000 Pounds/day Secondary Solids
91st Ave WWTP Digester Gas Production

- Raw Gas Production: Daily avg. & 30 day moving avg
- Gas Currently Flared: Daily avg. & 30 day moving avg
- Gas used for Heating: Daily avg. & 30 day moving avg

Average Biogas Flowrate (scfm)

Jan-05 Jan-06 Jan-07 Jan-08 Jul-05 Jul-06 Jul-07 Jul-08

- 0 250 500 750 1000 1250 1500 1750 2000 2250 2500 2750 3000

Raw Gas Production
Gas Currently Flared
Gas used for Heating
91st Ave WWTP Digester Gas Production

- 2.97M Cu Ft/day Total Gas Production
- 0.47M Cu Ft/day Digester Heating
- 2.51M Cu Ft/day Flared
- 1500 MBtu/day
Gas Utilization Strategies

- On-Site Power Generation: Heat Rate = 13,000 btu/kwh
- LNG
- Bio-solids Drying
- Pipeline Quality NG with Power Generated at Combined Cycle Plant: Heat Rate = 7,000 btu/kwh
Considerations

- Efficiency
- Revenue
- Emissions
- Carbon Offsets
Pipeline Quality Gas Cleaning Best Strategy

- Efficiency
- Revenue
- Emissions
- Carbon Offsets

Green Power Produced At High Efficiency Power Plant

El Paso Gas Line

Digesters

Currently Land Application

2.5 mcf/da summer
1.8 mcf/da winter

Foam/Sediment
H₂S
Siloxane
CO₂
Sempra Energy Will Contract To Purchase Raw Gas and Generate Green Power

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Emissions Favor Pipeline Quality Gas Cleaning

Emissions of Different Combustion Technologies

- CO
- NOx
- PM
- SOx

Title V Thresholds

Potential to Emit-Tons per Year

Existing Flare  Gas Cleaning  IC  Boiler  Fuel Cell  Microturbines
El Paso Pipeline Convenient To 91st Ave WWTP
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<thead>
<tr>
<th>Parameter</th>
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<th>Pipeline Gas</th>
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<td>Pressure</td>
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Gas Cleaning Schematic

- **H₂S Removal:** Chemical Scrubber
- **Siloxane Removal:** Adsorption Media
- **CO₂ Removal:** Pressure Swing Adsorption
H₂S Removal

- Wet Scrubber
- Proprietary Chemicals
- Sulfur Cake Disposal
Siloxanes

- Family of man-made organic silicon compounds (Silicon, oxygen, and methane)
- Relevant to WWTP and landfills only
  - From consumer products
  - Volatilizes under digestion conditions
  - Can deposit silicon dioxides when burnt
Siloxane Removal

- Adsorption
  - Activated Carbon
  - Proprietary Media
Pressure Swing Absorption (PSA)

- Zeolite or other solid sorbent in packed bed
- Impurities that can be captured depends on the solid
- Simpler than a solvent system

IEA, 2003
H₂S/Siloxane Gas Cleaning Schematic

Gas Source
- 90-100 °F

Booster (5 psig)

Gas Source

Compressor
- 200 °F
- 130 psig

Coalescer
- 112 °F

Gas/Gas Exchanger

Chiller
- 77 °F

Gas/Liquid Exchanger

Condenser
- 300 °F

Hot Gas Source

Drain

PSA System

H₂S Removal

125 psig

98% + Methane

Stage 1 Compressor

98% + Industrial Grade CO₂

Stage 2 Compressor

600 psig +

To Pipeline

Heat to Recovery

Condenser

Regenerant Gas To Discharge

Drain

To Pipeline

40 °F at Pressure Dew Point

Courtesy of AFT
Typical Cleaning System Installation

H₂S removal tanks

Gas conditioning skid

Siloxane removal tanks