Automated Well Field Control

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About the presenter

ANDY CAMPANELLA

- B.S. Electrical Eng. and Computer Science at MIT
- M.S. in System Design and Management at MIT
- Founder and CEO of Loci Controls, Inc.
- Inventor on 35 US patents, dozens of applications
- Expert in control systems, instrumentation, power systems, and electronics
Outline

- Typical Landfill Gas Collection Process
- Remote Monitoring and Automatic Control
- Well Tuning vs. Well Field Tuning
Typical gas collection system

1. Trash generates methane gas
2. Gas collected from wells
3. Gas burned to generate electricity
4. Electricity sold to the grid

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Drawbacks of typical collection system

- Manual surveys of well field are very labor intensive
- Infrequent measurement & tuning due to time/effort required
- Well adjustments are an art rather than a science
Automated well field control system

**MONITOR**
real-time, wireless measurement of landfill gas production

**CONTROL**
remote, automatic adjustments to individual extraction points

**OPTIMIZE**
maximize system performance with custom tuning algorithms

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Integrated measurement and control

**Monitor**
real-time, wireless measurement of landfill gas production
- Gas Composition: % CH₄, CO₂ & O₂
- Temperature
- Flow rate
- Well Static Pressure
- System Vacuum

**Control**
remote, automatic adjustments to individual extraction points
- Remotely actuated valve
- Continuous resolution, 0-100% range
- Variable control interval, step size

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OPTIMIZE
maximize system performance with custom tuning algorithms

- Set custom alarms
- Instantly identify problems
- View real time data
- Energy analytics
Control system objective

Gas Extraction = Gas Generation

(Controlled via static pressure adjustment) (Sensitive to external factors, weather, etc.)

Successful well tuning:

- Stable gas quality
- Minimized emissions/odors
- Long term maximization of methane generation
- Low risk of underground thermal runaway

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Typical Well Behavior

- **Applied Vacuum**
  - Weak
  - Strong

- **Flow**
- **Energy Extraction**
- **Gas Quality**

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What's wrong with this picture?
Well to well interactions

Influence of Well B on A

$$\frac{\partial LFG_A}{\partial t} \approx f(x_1, x_2, \ldots) + f(LFG_B)$$

Influence of Well A on B

$$\frac{\partial LFG_B}{\partial t} \approx f(x_1, x_2, \ldots) + f(LFG_A)$$

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Well to well interactions

Well B must first overcome excess vacuum from A and C!
Well to well interactions

Better configuration from a system perspective!

Extraction Zone A
Extraction Zone C

Well A
Well C

Well B

Extraction Zone B

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Case Study – Well Field Tuning

December 2015 – January 2016
Push extraction towards "dead" wells

Total Flow: 375 SCFM
Flow at 50% CH4 (SCFM)

2016-01-06 15:00

Total Flow: 425 SCFM
Potential for system automation

- Improved LFG collection efficiency
- More gas = more LFGTE revenue
- Odor control by reducing fugitive emissions
- Labor savings – more efficient use of technician time
THANK YOU!

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