Leak Monitoring, Research & Development Advances

Natural Gas STAR/Methane Challenge

Paul D. Wehnert

p.wehnert@heathus.com
Companies Heath Works With
Companies Heath Works With

- Sempra Energy
- Enbridge
- Kinder Morgan
- NiSource
- SCANA Energy
- PSEG
- SDGE
- Piedmont Natural Gas
- New Mexico Gas Company
- TECO
- National Grid
- PG&E
Personal Monitors

- LEL
- Carbon Monoxide
- Hydrogen Sulfide
- Oxygen
- Single Gas
- Multiple Gas
- Automated Calibration Docking Stations
Combustible Gas Indicators

• Confined Space Monitors
• Volume Gas
• Amplified Catalytic Sensors for PPM
• Semi-conductor for track gas / PPM
• Custom Configurable
• Leak / Odor Investigation tool
• Automated Calibration Docking Stations
Gasurveyor 700 Series
Compliance Leak Survey Instruments

- Low level PPM capability
- Volume Gas
- Flame-ionization
- Optical Infrared
- Laser
- Portable
- Vehicle Mounted
EyeCGas® Infrared Imaging Camera
RMLD-UAV

- Advanced sUAV suitable for all weather flight
- Auto search, detection, localization and flux quantification
- Methane specific
- Open path bi-static Tunable Diode Laser Absorption Spectroscopy
Portable Standoff Near-IR TDLAS for Leak Survey

- Laser beam illuminates a distant surface
- Senses analyte gas between transceiver and illuminated surface
  - Standoff range ~100 ft with handheld transceiver
- Scanning laser beam across plume results in rapidly changing analyte gas measurement
- ~2500 RMLDs™ in use for natural gas leak surveying

Remote Methane Leak Detector (RMLD™)
Commercial product (since 2005)

CO₂ version demonstrated at CCS test site wellhead during maintenance

Open Path Pipeline Monitors

- Permanent laser-based open-path alarms to detect and mitigate small to potentially explosive leaks
  - Wireless, solar-powered
  - Easy installation and alignment
  - Real-time alarm notification
- Operator alert within one minute of urgent leak detection
- Hourly notification of non-urgent leaks, enabling proper operator assessment and response
- Enabled by proven, industry-accepted RMLD™ technology
- CH₄ version demonstrated at PGE Livermore CA Training Center
  - 580’ path
  - Months of maintenance-free operation
- CO₂ version tested for more than two years at PSI and Illinois-Basin Decatur Project (IBDP) CCS Site
Remote Emissions Monitor (RMLD-REM)
Network of Methane Sensors

- Leverage existing proven AMI network technology with enabling sensor technology
  
  automated
  reliable
  low cost
  mass market
  networked leak detection device
Vision for Gas AMI System
Layered Gas System Monitoring

• Residential
  • One or more sensor modules placed by meter or indoors
• Distribution system
  • High consequence area monitoring
  • Gate stations
  • Valve enclosures
• Light Industrial
  • Sensor module integrated with a volume corrector or data monitor
• Transmission system
  • High consequence area monitoring
### Acknowledge

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Device ID</th>
<th>Premise</th>
<th>Address</th>
<th>CH4 Level</th>
<th>CH4 TLL</th>
<th>Severity</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/19/2012 1:03 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>19.8</td>
<td>4.0</td>
<td>LEVEL CRIT</td>
<td>RESOLVED</td>
</tr>
<tr>
<td>4/17/2012 1:08 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>24.1</td>
<td>4.8</td>
<td>LEVEL CRIT</td>
<td>RESOLVED</td>
</tr>
<tr>
<td>4/17/2012 1:08 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>35.0</td>
<td>5.0</td>
<td>LEVEL CRIT</td>
<td>DISPATCHED</td>
</tr>
<tr>
<td>4/16/2012 4:25 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>21.1</td>
<td>4.5</td>
<td>LEVEL CRIT</td>
<td>RESOLVED</td>
</tr>
<tr>
<td>4/16/2012 4:17 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>20.7</td>
<td>4.5</td>
<td>LEVEL CRIT</td>
<td>RESOLVED</td>
</tr>
<tr>
<td>4/16/2012 4:22 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>20.7</td>
<td>4.7</td>
<td>LEVEL CRIT</td>
<td>RESOLVED</td>
</tr>
<tr>
<td>4/16/2012 4:27 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>13.1</td>
<td>1.2</td>
<td>LEVEL CRIT</td>
<td>RESOLVED</td>
</tr>
<tr>
<td>4/16/2012 4:16 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>25.0</td>
<td>5.0</td>
<td>LEVEL CRIT</td>
<td>RESOLVED</td>
</tr>
<tr>
<td>4/16/2012 4:15 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>31.2</td>
<td>5.2</td>
<td>LEVEL CRIT</td>
<td>RESOLVED</td>
</tr>
<tr>
<td>4/16/2012 4:10 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>22.5</td>
<td>4.2</td>
<td>LEVEL CRIT</td>
<td>RESOLVED</td>
</tr>
<tr>
<td>4/16/2012 4:39 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>20.3</td>
<td>4.0</td>
<td>LEVEL CRIT</td>
<td>RESOLVED</td>
</tr>
<tr>
<td>4/16/2012 4:34 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>55.3</td>
<td>2.0</td>
<td>LEVEL CRIT</td>
<td>DISPATCHED</td>
</tr>
<tr>
<td>4/16/2012 4:31 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>30.2</td>
<td>4.2</td>
<td>LEVEL CRIT</td>
<td>DISPATCHED</td>
</tr>
<tr>
<td>4/16/2012 4:29 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>34.4</td>
<td>4.5</td>
<td>LEVEL CRIT</td>
<td>DISPATCHED</td>
</tr>
<tr>
<td>4/16/2012 4:26 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>35.2</td>
<td>4.1</td>
<td>LEVEL CRIT</td>
<td>RESOLVED</td>
</tr>
<tr>
<td>4/16/2012 4:25 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>33.9</td>
<td>2.8</td>
<td>LEVEL CRIT</td>
<td>RESOLVED</td>
</tr>
<tr>
<td>4/16/2012 2:24 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>27.5</td>
<td>1.9</td>
<td>LEVEL CRIT</td>
<td>RESOLVED</td>
</tr>
<tr>
<td>4/16/2012 12:21 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>23.2</td>
<td>1.2</td>
<td>LEVEL CRIT</td>
<td>RESOLVED</td>
</tr>
<tr>
<td>4/16/2012 12:21 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>22.1</td>
<td>4.3</td>
<td>LEVEL CRIT</td>
<td>RESOLVED</td>
</tr>
<tr>
<td>4/16/2012 12:21 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>22.2</td>
<td>4.3</td>
<td>LEVEL CRIT</td>
<td>RESOLVED</td>
</tr>
<tr>
<td>4/16/2012 12:19 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>51.6</td>
<td>24.5</td>
<td>LEVEL CRIT</td>
<td>NEW</td>
</tr>
<tr>
<td>4/16/2012 12:19 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>21.1</td>
<td>15.7</td>
<td>LEVEL CRIT</td>
<td>NEW</td>
</tr>
<tr>
<td>4/16/2012 12:12 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>13.9</td>
<td>20.5</td>
<td>LEVEL CRIT</td>
<td>NEW</td>
</tr>
<tr>
<td>4/16/2012 12:03 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>22.3</td>
<td>27.3</td>
<td>LEVEL CRIT</td>
<td>NEW</td>
</tr>
<tr>
<td>4/16/2012 12:03 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>27.5</td>
<td>10.4</td>
<td>LEVEL CRIT</td>
<td>NEW</td>
</tr>
<tr>
<td>4/16/2012 12:03 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>11.5</td>
<td>13.2</td>
<td>LEVEL CRIT</td>
<td>NEW</td>
</tr>
<tr>
<td>4/16/2012 12:02 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>11.3</td>
<td>23.3</td>
<td>LEVEL CRIT</td>
<td>NEW</td>
</tr>
<tr>
<td>4/16/2012 11:25 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>10.3</td>
<td>18</td>
<td>LEVEL CRIT</td>
<td>NEW</td>
</tr>
<tr>
<td>4/16/2012 11:53 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>22.5</td>
<td>18.5</td>
<td>LEVEL CRIT</td>
<td>NEW</td>
</tr>
<tr>
<td>4/16/2012 11:53 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>14.6</td>
<td>16.2</td>
<td>LEVEL CRIT</td>
<td>NEW</td>
</tr>
<tr>
<td>4/16/2012 11:52 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>20.8</td>
<td>11.7</td>
<td>LEVEL CRIT</td>
<td>NEW</td>
</tr>
<tr>
<td>4/16/2012 11:51 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>19.5</td>
<td>20</td>
<td>LEVEL CRIT</td>
<td>NEW</td>
</tr>
<tr>
<td>4/16/2012 11:50 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>16.7</td>
<td>18.4</td>
<td>LEVEL CRIT</td>
<td>NEW</td>
</tr>
<tr>
<td>4/16/2012 11:47 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>20.3</td>
<td>10.4</td>
<td>LEVEL CRIT</td>
<td>RESOLVED</td>
</tr>
<tr>
<td>4/16/2012 11:47 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>11.5</td>
<td>110.9</td>
<td>LEVEL CRIT</td>
<td>CLEAR</td>
</tr>
<tr>
<td>4/16/2012 11:42 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>11.5</td>
<td>110.9</td>
<td>LEVEL CRIT</td>
<td>CLEAR</td>
</tr>
<tr>
<td>4/16/2012 4:07 PM</td>
<td>033909766</td>
<td>Residence</td>
<td>640 S St. Selestown, MN 55003</td>
<td>24.1</td>
<td>4.8</td>
<td>LEVEL CRIT</td>
<td>RESOLVED</td>
</tr>
</tbody>
</table>
MobileGuard
Ultra Sensitive Mobile Monitoring

• High sensitivity sensor
  • Parts per billion (ppb)
  • Instantaneous response

• Mobile Platform
  • Geo-located measurements
  • Survey quickly and efficiently
  • Simple configuration (easy install)

• Leak Detection Software
  • Easy to use interface
  • Real-time plotting of leak Indications
  • Real-time gas discrimination
  • GIS compatible
Development of Next Generation Mobile Monitoring

• Vehicle-mounted sensors have a long history and have been extensively vetted - Developed in 1995 have
• Gone from legacy Cavity Ringdown to OA-ICOS
• Started mobile survey use and perfecting survey methodology since 2010
• Allows for cost-effective surveys of large areas at a rapid pace
• Requires:
  • Manufacturable, easy-to-use gas sensors that do not require researchers
  • Complete sensor suite - sensor, GPS, anemometer, gas inlet...
  • Leak detection software – analysis interpretation, leak aggregation
  • Data presentation user interface
MobileGuard Technology
Patented Off-Axis ICOS (OA-ICOS)

- Patented 4\textsuperscript{th} generation cavity-enhanced technique
- Optical path provides very long pathlength
- Increased dynamic range
- Very robust – exact alignment is not critical, enabling mobile monitoring
- All advantages of conventional TDLAS, with increased sensitivity (ppb) and dynamic range
MobileGuard Solution
MEA for Mobile Monitoring

Mechanical Features

• 19” rack compatible
• 4U High (7”)
• 12 VDC
• Integrated Pump
• Integrated GPS Receiver
• Water Trap
• Humidity Interlock
Vehicle Integration

Methane, location and wind speed are analyzed by the computer to create leak indications.
User Interface

Measured Data and Automated Alarms

- Real-time Status
- Leak Indications List
- Methane Time Chart
Drive Reports
Available Formats

PDF
• Printable, static file
• Universally sharable

KMZ/KML
• View in Google Earth
• Import layers into GIS

Proprietary XML
• Machine readable
• Database import