Weatherford District Office Aerial View

FLIR Camera Highlights

- Real time detection
- Facilitates location & repair of leaks
- Ability to screen hundreds of components quickly from near or far (Zoom Lens)
- Ability to record/document leaks and repairs for record keeping
- Waveband range is 3 - 5 micrometers window
- Depends on object temperature, reflections, and medium (air) between camera and object.
- Methane content ranges from 80-98%
- Methane or leaking gas causes a temperature differential (enables the camera to isolate the difference in the ambient air)
Absorption Characteristics of Methane

Detection Capabilities of a FLIR Camera

- Benzene
- Ethanol
- Ethyl benzene
- Heptane
- Hexane
- Methanol
- MEK
- MIBK
- Octane
- Pentane
- 1 - Pentene
- Toluene
- Zylene
- Butane
- Ethane
- Methane
- Propane
- Ethylene
- Propylene
Get training
Survey for leaks, emphasize high pressure - high volume areas.
Measure leaks (bag test) if possible
Document leaks. Tag or fix “on the spot”
Maintain spreadsheet/database of leak inspection and repairs.
Follow-up on requested repairs....
Update STARtracker

### FLIR CAMERA INSPECTIONS

<table>
<thead>
<tr>
<th>Well/Facility/CDP Name</th>
<th>MidCon Unit #</th>
<th>Inspection Date</th>
<th>Leak Location</th>
<th>Component</th>
<th>Tagged?</th>
<th>Operator</th>
<th>Leak Rate (SCF/D)</th>
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<tr>
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### Tracking

- **Barnett - Cleburn**
  - Glenn Stetson
  - Grant Macdonald
  - Greg Kochenower
  - Larry Ross
  - Travis Brown
  - Dustin Durkee
  - Neal Poindexter
- **Barnett - Tarrant**
  - W. Mid Cont
  - Anadarko
  - Arkoma
  - Arkoma
  - Arkansas
- **Districts:** Barnett - Cleburn, Barnett - Tarrant, W. Mid Cont, Arkoma, Arkansas
- **Inspectors:** Glenn Stetson, Grant Macdonald, Greg Kochenower, Larry Ross, Travis Brown, Dustin Durkee, Neal Poindexter
FLIR Camera Limitations

- Distance Range past 100 feet
- Gas cloud differential needed
- Strong winds & small leaks – tough situation
- Rainy and misty days

Video Examples

Two-Inch Union Leak
Compressor Vent

Compressor Packing - Gas Loss Video
Compressor Suction Control  Valve Gas Loss

Fuel Gas Scrubber Union Leak
Fuel Gas Regulator Valve

Video – Fuel Gas Regulator
Summary of Common Leaks

PRODUCTION EQUIPMENT
- Pressure, relief, and control valves.
- Level and pressure controllers.
- Connections types: unions, threaded flanges, and piping
- Tank venting

ENGINES and COMPRESSORS
- Compressor pressure packing.
- Controller types: fuel, pressure, and level.
- Regulator venting.
- Compressor valve caps and loading pockets.

Generally Speaking
- Leaks that are not visible
- Leaks that are not heard
- Leaks that are not smelled

Summary of Weatherford Camera Experience

District Inspection
- Less than 3% of area completed during pilot
- Estimate a full year to inspect this district properly
- Re-inspection of repairs: needs done

Camera Justification
- Environment, Safety, Savings, and Economics
- Results + Potential justify a full time Camera Tech/DI&M program
- Due diligence inspection
- More cameras company wide?
- Purchase High Flow Sampler?
- New well (initial) inspections with camera – great idea
- New equipment installation – warrants inspection
Results - FLIR Camera DI&M:

● Simple Economics of “fixed on the spot”, Equipment repair, Replace equipment for demo period:
  Approximate repair costs = $15,000
  Emissions Reductions = 160 MCFPD

● 160 MCFPD recovered @ $3.50/MCF = $204,400 annual savings

● Many leaks could be fixed on the spot with no extra costs by FLIR Technician.

● Majority (50% to 75%) of the leaks found with the FLIR camera would otherwise go undetected.

● It is sometimes difficult to quantify leak rates (with a calibrated bag). Owning a High Flow Sampler may be necessary.