Airborne Leak Detection

Comparing Technologies

System Types

- Tunable Diode Laser
- Infrared Camera
- Sniffer

Basic Laser Operation

- Laser is tuned to the absorption wavelength of the chemical of interest
- A portion of the laser energy is absorbed by the chemical of interest
- Laser return signal measured to determine amount/existence of the chemical in the atmosphere

Basic Infrared Camera Operation

- Video camera with filter which records a select spectrum of infrared wavelengths
- Within these wavelengths, certain hydrocarbons absorb infrared radiation.
- Those hydrocarbons are seen as “smoke” in the video imagery

Basic “Sniffer” Operation

- Helicopter flies low to pass through gas plume
- “Sniffer” extracts a sample of air into its analyzer
- Analyzer determines presence and concentration of gas present in the sample

Service Providers

- Aviation Technology Services (ATS)
- Pergam – Suisse
- ITT
- LaSen ALPIS
- LSI
- Apogee Scientific

Aviation Technology Services

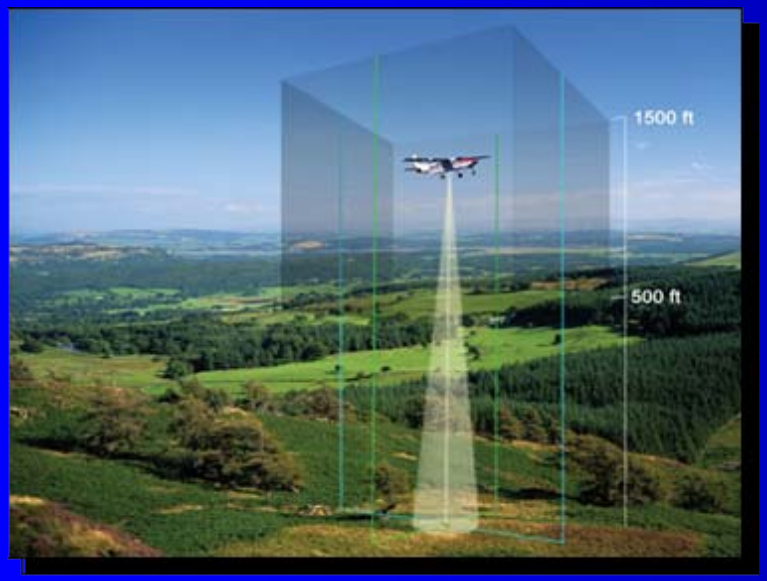
- Uses Boreal Laser's "GasFinderAB" System
- Tunable Laser mounted on helicopter
- Helicopter must pass into/through gas plume to detect leak
- Helicopter flies 25-50ft above ground

Pergam-Suisse

- Airborne Laser Methane Assessment System – “ALMA”
- Tunable Laser mounted on helicopter
- Laser beam path 18” wide

ITT

- Airborne Natural Gas Emission Lidar – “ANGEL”
- Tunable Lasers mounted in a fixed-wing aircraft
- Laser Beam path 100’ wide
- Flies transmission (long, straight) pipelines



LaSen ALPIS

- Airborne Lidar Pipeline Inspection Service – “ALPIS”
- Tunable Laser mounted on helicopter
- Laser beam path 40’ wide
- Successfully flown over 45,000 miles of gathering/transmission lines (detecting over 6,000 leaks) with many repeat customers

LaSen ALPIS

- Eye safe laser
- Fires at 400 Hz
- Flies 150-500ft AGL
- Flies up to 60mph
- Various aerial platforms
- Operators are OQ’d

LSI

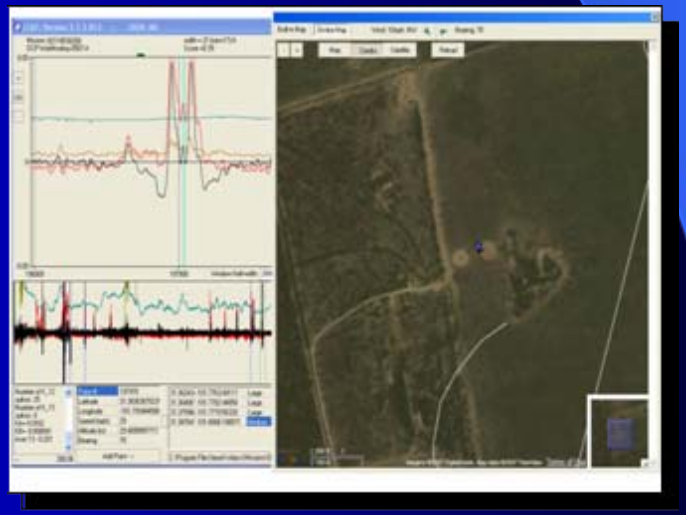
- “Hawk” Camera (FLIR’s “GasFindIR” infrared camera)
- Infrared Camera mounted on helicopter
- System relies on an operator visually identifying gas in video imagery

Apogee Scientific

- Leak Detection System – “LDS”
- A helicopter mounted “sniffer” that pulls in an air sample for analysis
- Helicopter flies 25-50ft above ground in order to pass into/through gas plume to detect leak

Sensitivity

- ITT ANGEL – 50ppm-m
- LaSen ALPIS – 5ppm-m
- LSI – Less than 10,000ppm-m



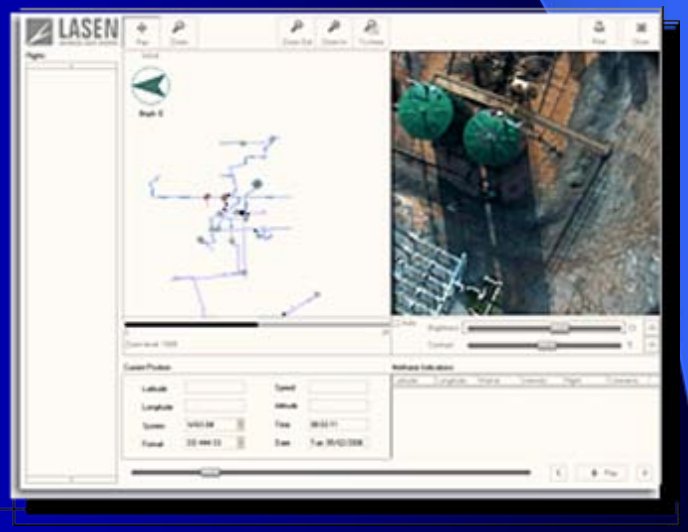
Weather Restrictions

(Note: All aircraft are restricted by inclement weather: heavy fog, heavy rain, high winds)

- **ITT ANGEL has accurate data at winds less than 12mph**
- **LaSen ALPIS has had accurate data at winds up to 45mph**
- **Higher winds disperse gas quickly, which makes it harder to see with a passive system, such as LSI's Infrared Camera**

Reporting Results

- ITT - Software package which includes GPS location of leaks, maps, and digital imagery of ROW delivered 2-4 weeks after survey
- LaSen – Secure online database includes GPS location of leaks, maps, digital and satellite imagery of ROW available online 1-12 hrs after survey. Hard copy of report and software package delivered 1 week after survey.
- LSI – Hard copy of report with GPS location of leaks and video imagery delivered 2-3 weeks after survey.



Factors to Consider

- Safety
- Sensitivity
- Gathering/Distribution vs. Transmission
- Reliable Results
- Report Availability
- Survey Cost
- References