LASEN

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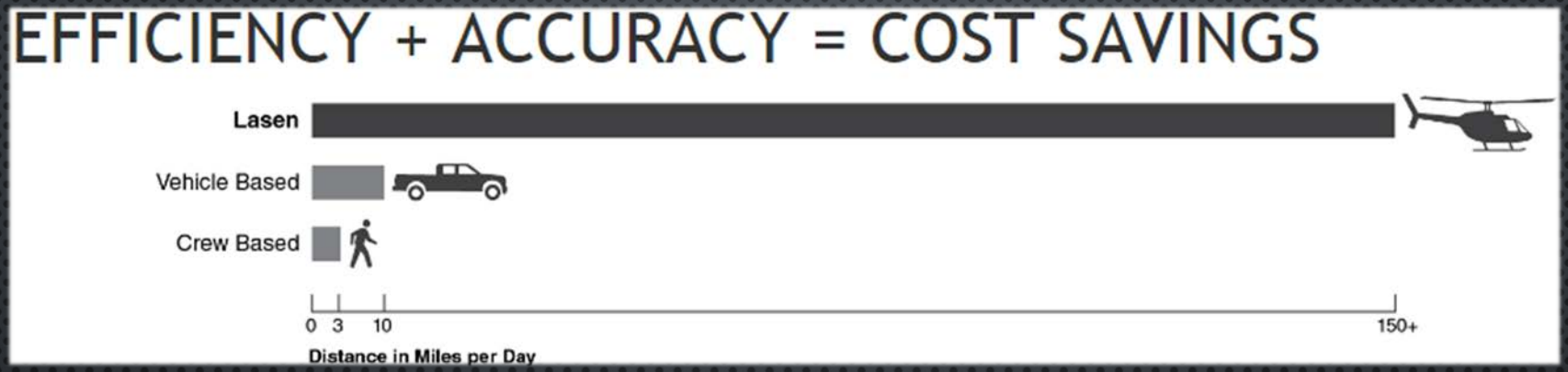
WHO IS LASEN, INC.

- Incorporated 1989
- Zero safe incidents since the inception of the company
- Design/built remote laser detection technology for Department of Defense
- Application – detecting biological chemical gases
- Wright Patterson AFB Research Funded By Dept. of Defense
- DOT/PHMSA grants research & development funding to LaSen in 2001-2007. See DOT/PHMSA's web site for Lasen's published accomplishments and unmatched capabilities
- Inspected over 250,000 miles of gathering & transmission pipeline

AIRBORNE LEAK DETECTION



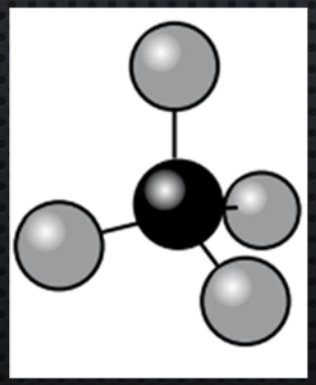
- Eliminates access issues with land owners. No locked gates, angry dogs…
- No issue driving/walking over rough terrain
- Personnel can watch the video and focus on finding/fixing problems FAST vs. walking the pipeline
- By watching the video, personnel can identify: encroachments, erosion, vegetation discoloration, down pipeline markers and CP test markers, unidentified structurers, and unmaintained sections of pipeline ROW

WHAT DOES A PIPELINE INCIDENT REALLY COST?

- Civilian Causalities in HCA areas
- Environmental damages
- State and Federal regulatory fines
- Cost of lost gas
- Significant financial impacts
- Lawsuits…
- Better to locate small leaks before they become large… (reduces repair time & cost)

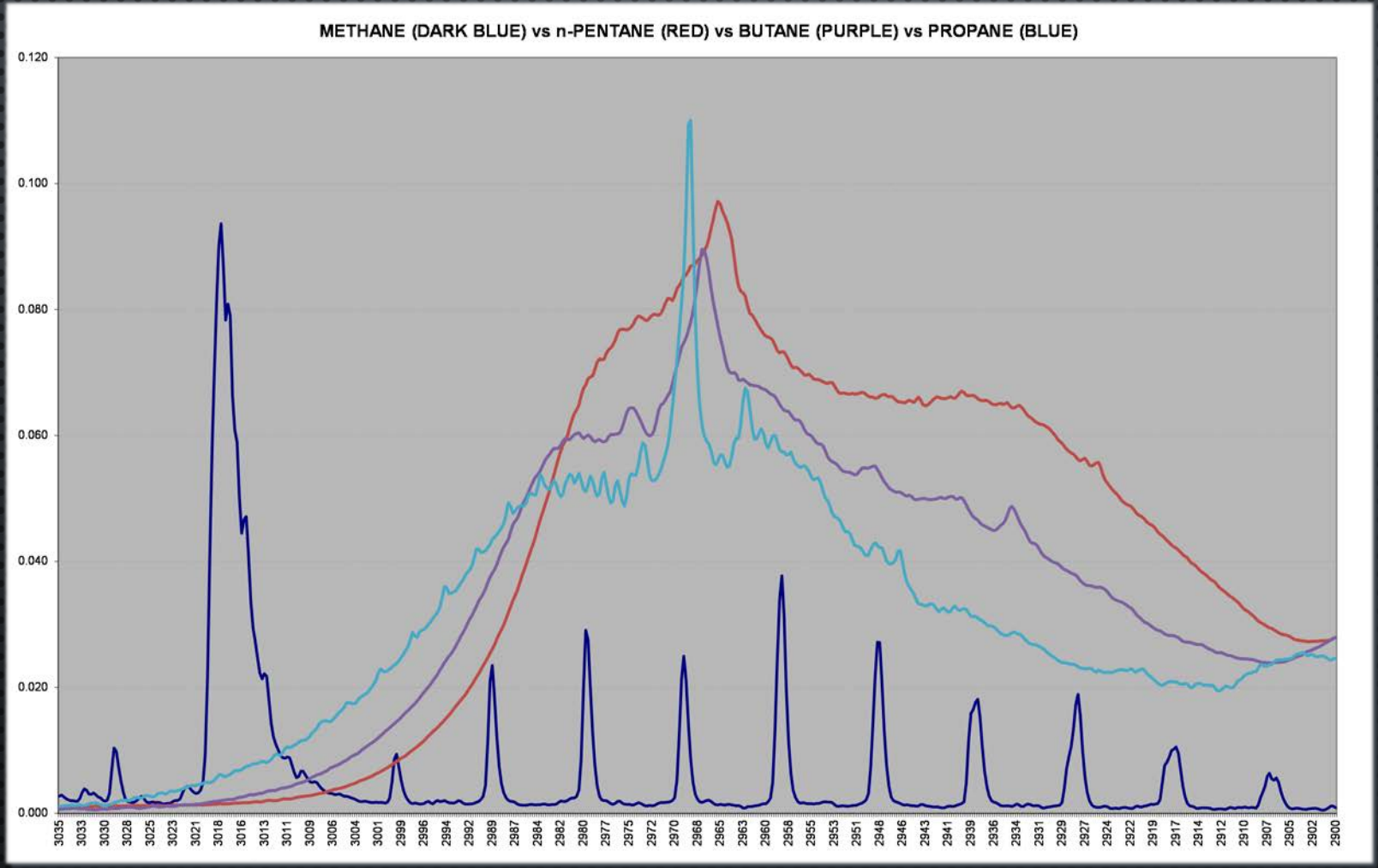
TYPES OF AERIAL LEAK DETECTION SYSTEMS

- Tunable Lasers Systems (Active)
- Airborne Sampling Solutions (Sniffers)
- Infrared Camera (FLIR)
- Gas Correlation Radiometers



Did you know? Methane molecule's absorb infrared energy (photons) and vibrate…

ABSORPTION OF LIGHT IN INFRARED

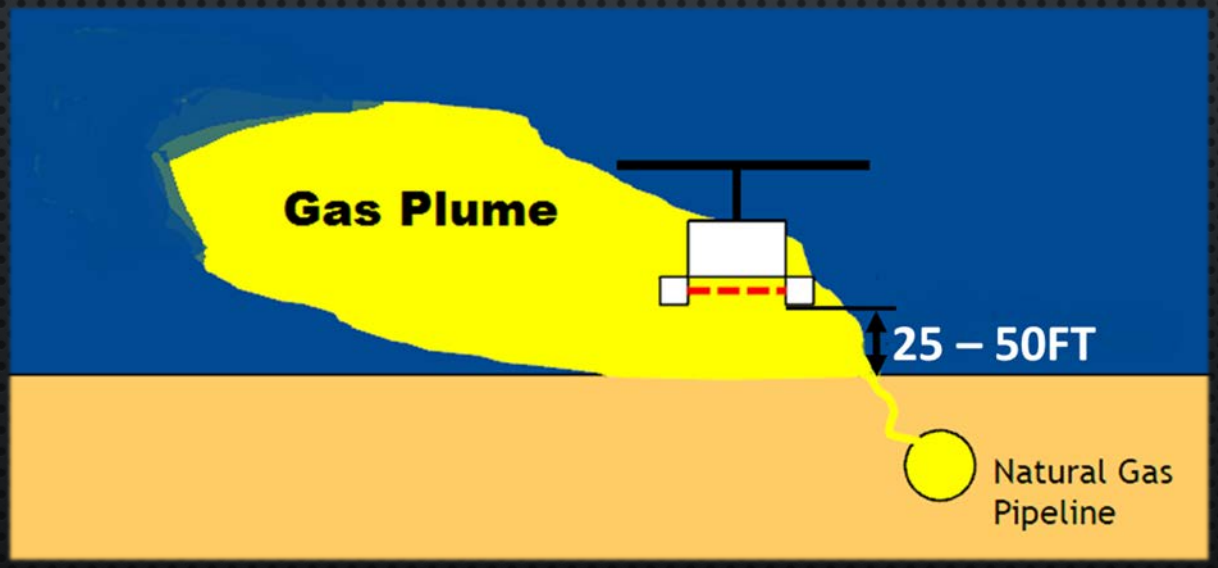


AIRBORNE SAMPLING SOLUTIONS (SNIFFERS) - APOGEE

- AIR IS SUCKED INTO THE HELICOPTER MOUNTED INSTRUMENT AND ANALYZED FOR HYDROCARBONS
  - AIR IS ANALYZED BY SEVERAL TECHNOLOGIES… FLAME IONISATION DETECTORS (FID), SPECTROSCOPY, OPTICAL METHANE DETECTION (OMD), ECT.
- A WIDE VARIETY OF HYDROCARBONS CAN BE DETECTED WITH HIGH ACCURACY, BUT HELICOPTER ROTOR WASH OR WIND DISSIPATES SMALL PLUMES BEFORE THEY REACH THIS EQUIPMENT (TYPICALLY 25 – 50 FT)

AIRBORNE SAMPLING SOLUTIONS (SNIFFERS) - CONTINUED

- THE SNIFFER MUST PASS THROUGH THE METHANE PLUME. SMALL LEAKS WILL DISPERSE BEFORE REACHING THE HELICOPTER
- REQUIRES THE HELICOPTER TO FLY SLOW AND VERY CLOSE TO THE GROUND (25 – 50 FT)



INFRARED CAMERAS (FLIR, HEATH CONSULTANTS, LSI,…)

- SPECIALIZED VIDEO CAMERA WITH A FILTER WHICH RECORDS A SELECT SPECTRUM OF WAVELENGTHS IN THE INFRARED REGION
- WITHIN THESE WAVELENGTHS, CERTAIN HYDROCARBONS ABSORB INFRARED RADIATION
- HYDROCARBONS THEN CAN BE SEEN AS SMOKE IN THE VIDEO IMAGERY
- TEMPERATURE, SUNLIGHT, CAMERA ANGLE, AND WIND ARE CRITICAL

INFRARED CAMERA - CONTINUED

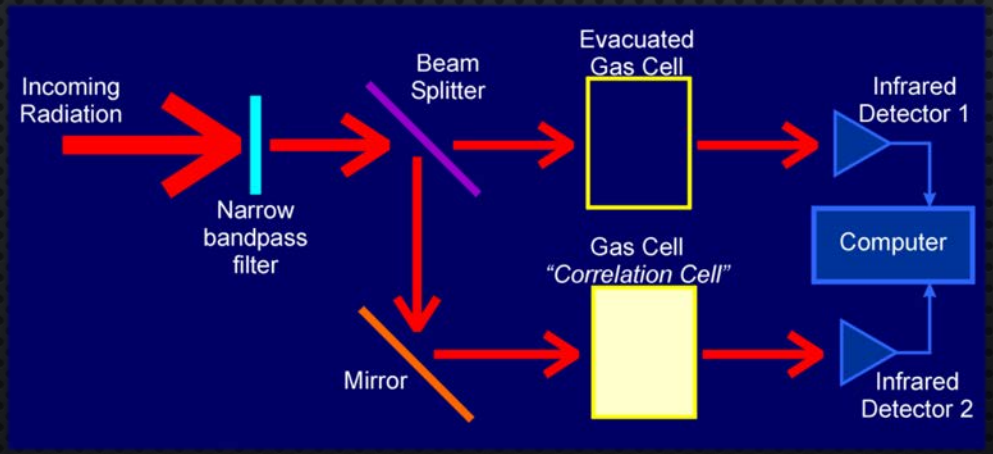
- INFRARED CAMERA MOUNTED ON HELICOPTER
- SYSTEM RELIES ON AN OPERATOR VISUALLY IDENTIFYING GAS IN VIDEO IMAGERY
- VERY USEFUL FOR SURVEYING LEAKS ON THE GROUND IN COMPRESSOR & GAS PROCESSING FACILITIES
- DIFFICULT TO SPOT ALL BUT THE LARGEST LEAKS FROM AN AERIAL PLATFORM BECAUSE SUNLIGHT, WIND, AND CAMERA ANGLE ARE CRITICAL

Key Concepts To Make The Cloud Visible

- The gas must absorb infrared radiation in the waveband that the camera can see
- The cloud must have a radiant contrast to the background
- The apparent temperature of the cloud must be different to the background
- Cloud motion assists the visibility of the gas

GAS CORRELATION RADIOMETERS - SYNODON

- ORIGINALLY DEVELOPED FOR SPACE (SATELLITE) MONITORING OF HYDROCARBONS IN THE ATMOSPHERE
- MEASURES THE AMOUNT OF INFRARED LIGHT REFLECTED BY THE EARTH FROM THE SUN
- VERY USEFUL FOR MEASURING LARGE GEOGRAPHIC AREAS

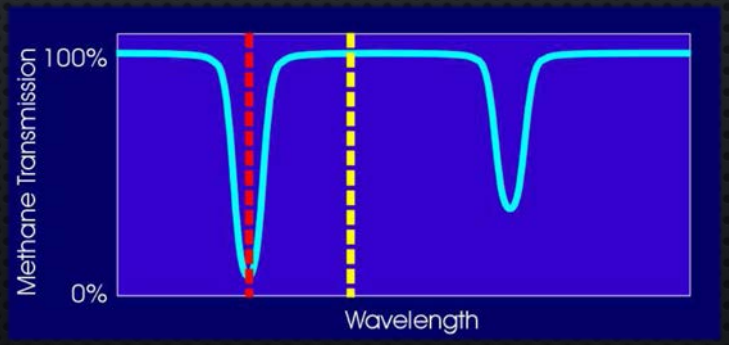


GAS CORRELATION RADIOMETERS - CONTINUED

- THE TECHNOLOGY REQUIRES INCIDENT SUNLIGHT, SO THE SYSTEM DOES NOT WORK WELL EARLY/LATE IN THE DAY
- SHADOWING CREATED BY CLOUDS OR CANYONS LIMITS THE TECHNOLOGIES ABILITY TO SEE METHANE
- PRODUCES LARGE AMOUNTS OF DATA THAT CAN TAKE A LONG TIME TO PROCESS

TUNABLE LASER SYSTEMS
BASIC LASER OPERATION

- ACTIVE LASER SYSTEMS
- LASER IS TUNED TO THE ABSORPTION WAVELENGTH OF METHANE MOLECULES
- LASER BEAM PASSES THROUGH ATMOSPHERE WITH A PORTION BEING ABSORBED BY METHANE
- LASER BEAM BOUNCES OFF THE GROUND (THE RETURN SIGNAL) AND IS MEASURED TO DETERMINE EXISTENCE OF METHANE IN ATMOSPHERE



BOREAL LASER SYSTEM

- Tunable Laser mounted under helicopter
- Helicopter must pass into/through gas plume to detect leak
- System is very sensitive and can be used to detect multiple hydrocarbons
- Requires the helicopter to fly low to the ground (25-50ft above ground)

PERGAM – AERIAL LASER METHANE ASSESSMENT (ALMA)

- 25 Hz Laser System – 25 measurements per second
- Beam footprint – 18” X 18” (2.25 sqft on the ground)
- Beam reflects off the ground and a portion of the beam is absorbed by gas plume
- 25 ppm*m sensitivity (at 165 ft)

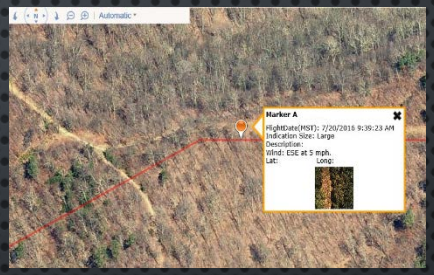
LASEN'S LASER SYSTEM (ALPIS) HOW IT WORKS:

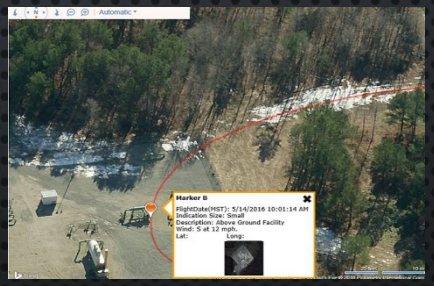
- 400 HZ Laser System – 400 pulses per second, locates the smallest of leaks vs. any other technology from an aircraft
- Laser footprint – 40' X 40' (1600 sqft on the ground)
- Two Laser pulses are reflected off the ground. One is absorbed by a methane plume and the passes through methane. The difference between the two pulses is used to detect methane
- Because laser is fired from the helicopter to the ground it is less likely to miss leaks

- GPS coordinates of the flight path and any methane indications and recorded
- Digital photos & HD video of the indication site (plus the entire flight) are recorded

LASEN LASER SYSTEM

- Locates the smallest of leaks from an aircraft
- Eye safe Laser
- Sensitive enough to detect leaks at vent casings and above ground facilities
- Flown at 300 - 500 ft, safely above power lines
- Rotor wash does not effect the plume
- Flown up to 60 mph
- Flown in winds up to 35 mph
- 5ppm*m sensitivity, locating leaks Inches above the ROW, unlike other airborne systems that must fly through the plume (at altitudes of 25 – 50 ft)





LASEN LASER SYSTEM

REPORTING RESULTS

- 1 - 12 HOURS AFTER SURVEY (IDEA FOR PRESSURE UPRATE)
- SECURE ONLINE DATABASE LOGIN
- GPS COORDINATES OF INDICATION, MAPS, DIGITAL, AND SATELLITE IMAGERY OF ROW
- HD VIDEOS OF ROW (125FT & 800FT WIDE VIEWS) ARE MAILED ONE WEEK AFTER SURVEY

Sensitivity of Detection Systems

- Synodon: better than 50 ppm*m
- Apogee: 0.25 ppm (wind & altitude considerations)
- Boreal: 0.2 ppm (wind & altitude considerations)
- LaSen: 5 ppm*m
- Infrared Camera: 10,000 ppm*m

WEATHER RESTRICTIONS:

- SNIFFER SYSTEMS: HIGH WINDS DISPERSE GAS QUICKLY MAKING IT DIFFICULT TO FLY THROUGH THE PLUME
- INFRARED CAMERA:
  - WINDS LESS THAN 10 MPH
  - REQUIRES DIRECT SUNLIGHT (NOT OVERCAST)
- TUNABLE LASER SYSTEMS:
  - ACCURATE IN WINDS 35 MPH
  - WORKS ON CLOUDY DAYS

FACTORS TO CONSIDER

- Locate & Fix Leaks Faster Saves $$$ On Lost Gas Cost
- Sensitivity to ensure you find the smallest leaks
- Reliable Results
- Report Turn Around Time Availability
- Survey Cost
- Flying eliminates land owner fences and overall land accessibility issues
- References

LASEN, INC. CREDENTIALS

- ISN Membership #400-141959
- Flight technician is Veriforce OQ qualified
- LaSen carries all required liability insurance
- References available upon request