JONAH ENERGY LLC

Comprehensive Methane Reduction Program

Howard R. Dieter, PE
Vice President, Environmental, Health & Safety

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Methane Emissions Reduction Program

- Comprehensive Methane Emissions Reduction Program

  ✓LDAR

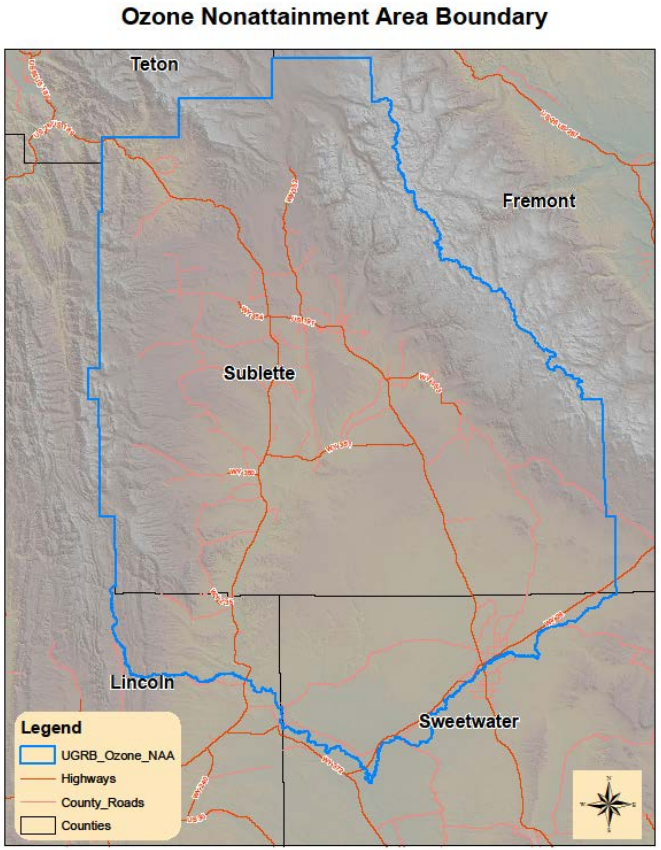
  ✓Record Drawings – accurately mapping new and existing facilities

  ✓Damage Prevention – Jonah Energy Utility Locate Program

  ✓Data storage/analysis in Asset and Compliance Tracking System (ACTS) and GIS Web Application

Background of Jonah LDAR program

- The Upper Green River Basin includes all of Sublette County, NW Sweetwater County and NE Lincoln County – the Jonah Field and Pinedale Anticline are located within the UGRB
- Between 2005 and 2011, UGRB experienced elevated levels of Ozone in wintertime as measured by air monitoring stations in the area
- Meteorological conditions impacting Ozone formation – snow cover, tight inversions, sunlight and low wind speeds
- WDEQ focus on reducing emissions levels of VOC and NOx, both precursors to Ozone formation
- Ozone Action Days – January – March
- Encana began using FLIR technology in 2005 and grew the program by 2010 to 4 full-time inspectors



LDAR Implementation

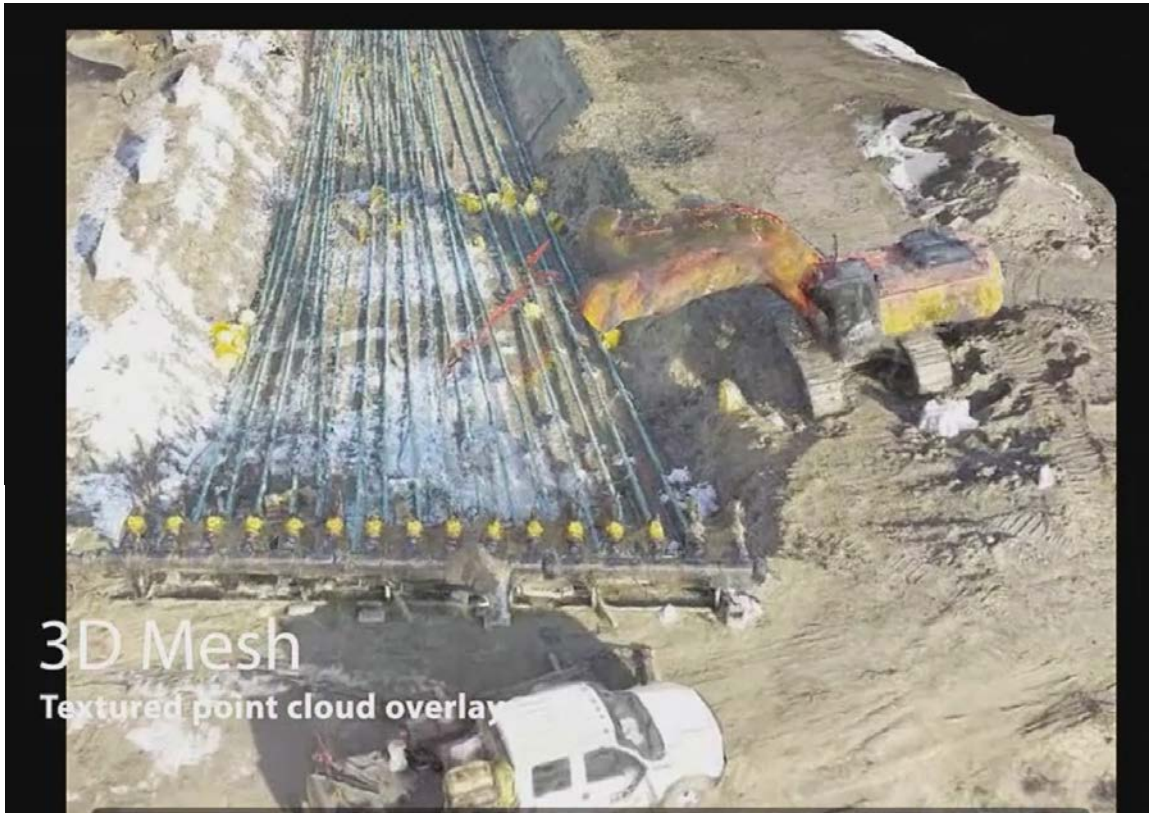
- All LDAR inspectors are FLIR certified and have been trained in operation of our production facilities
- Approximately 75% of leaks found are repaired by our LDAR inspector at the time of inspection
- Inspection conducted with handheld FLIR GF320 cameras
- Leak rates are determined using hi-flow sampling equipment
- Inspections take between 1.5 and 4 hours to complete depending on size of location

LDAR Results

- Leak repair attempted at time of inspection or within 24 hours. Follow-up inspection within 24 hours of repair.
- Achieved greater than 75% reduction in leaks compared with permitted fugitive emission estimates.
- In 2017, Jonah Energy doubled the number of facilities through LINN Energy acquisition; BUT,
- Cut the mt CH4 reported in EPA Equipment Leaks Surveys and Population Counts category by 44% in 2017 compared with 2016.
- The reduction was largely attributed to being able to use actual LDAR data to reduce leak time

Record Drawings

- Mapping new construction and existing facilities
- UAS reduces time to collect data
- Easily converts point cloud to ArcGIS and AutoCAD



VIPER DRONES

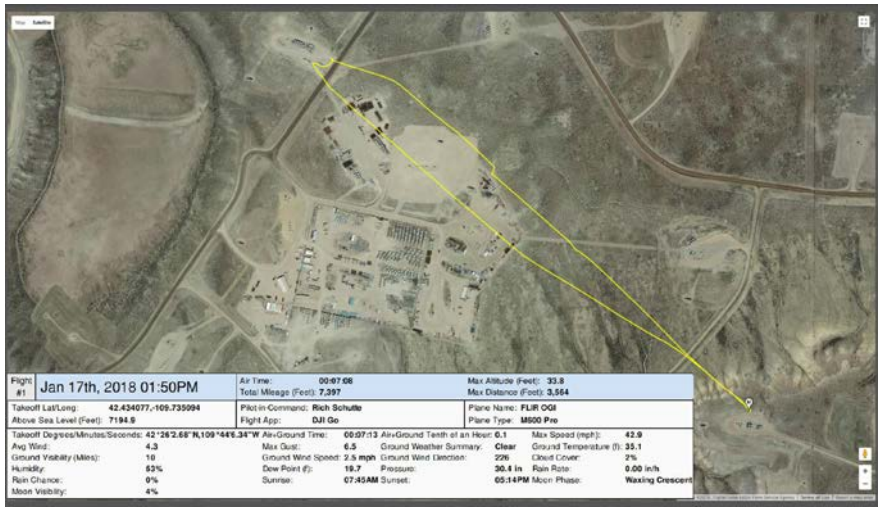
Damage Prevention

Jonah Energy Utility Locate Program

- Transferring ground marks to detailed, accurate mapping
- Fly location following utility locate ~ 10 minutes
- Focus Jonah Energy utility locator's time on locating, rather than mapping

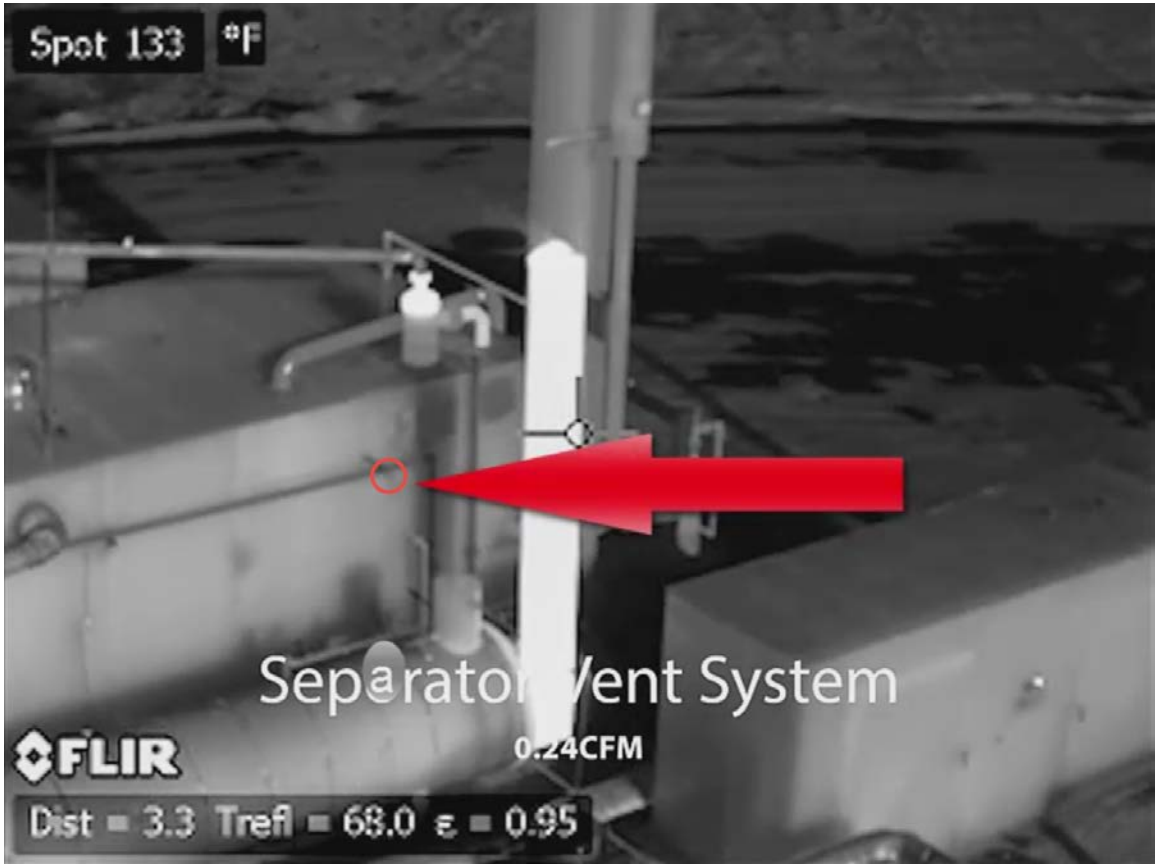
Drone-based LDAR

- Currently ~ 67% of inspections do not yield an actionable repair
- Proposed – fly locations ~ 15 minutes to see large leaks including tanks, vapor lines and external piping
- Flight pattern can be saved and consistently repeated



Drone-based LDAR

- 30% of leaks are detectable from the sky
- Those leaks represent 35% - 50% of leak volume
- Reduces inspection time by 75% on average
- Reduces trips up stairs to tank battery and limits respiratory protection requirements



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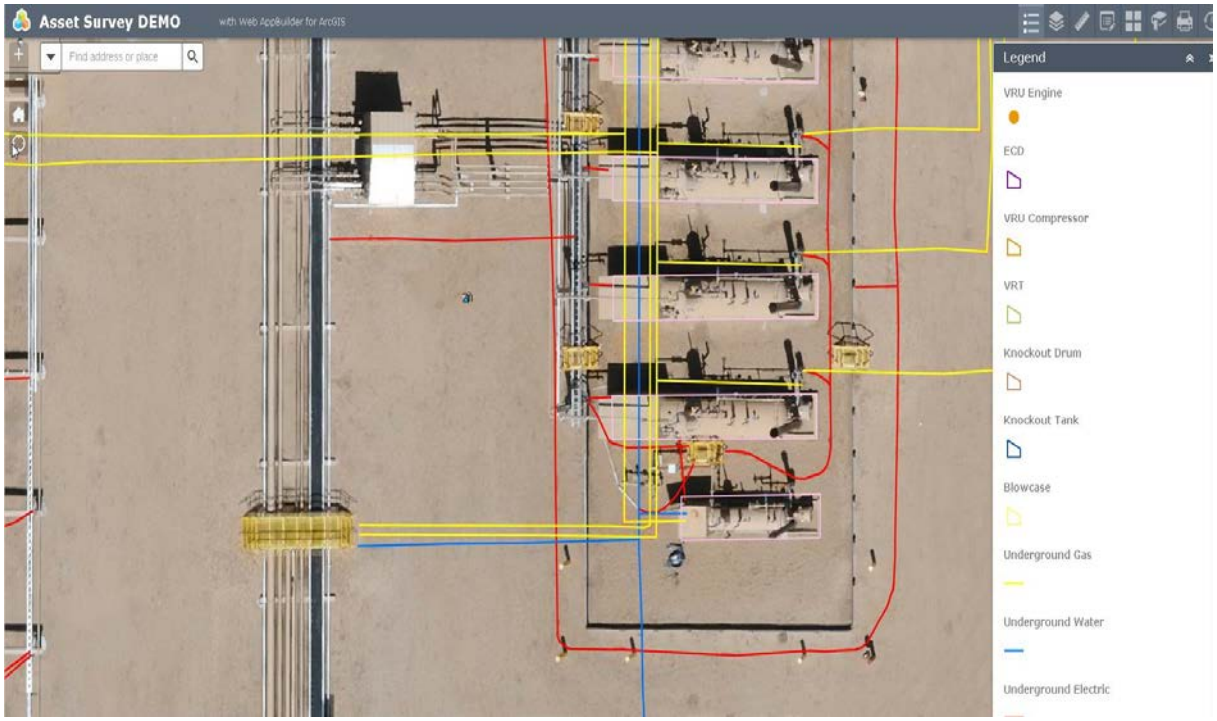
ArcGIS Web Application

- All assets are attributed and stored in a cloud-based database
- Employees are able to view and work with all facility information wherever they can connect to the web
- The web application includes links to:
  - Panoramas
  - Point Cloud
  - FLIR Video
  - Pictures



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Asset and Compliance Tracking System (ACTS)

- LDAR inspection data and site facility drawings are stored in ACTS
- LDAR inspection data collected with mobile app – Currently use ACTS/Field supported by Pronto Forms
- Able to run statistics on leaks through ACTS for operational guidance
- ACTS/ArcGIS Web application working together to identify trends and assist with future planning and budgeting

Enter Inspection Date Range	
Start Date:	7/1/2019
End Date:	7/31/2019

Note: Change the date range or leak rate ranges (highlighted in yellow) to adjust the data set

Inspection Data	
Total Number of Inspections:	145
Inspections With Actionable Leaks:	29
Percent Inspections with Leaks:	20%

Leaks By Equipment

Equipment	Leak Count	Leak %
Compressor	2	4%
Dehy	6	13%
Engine	0	0%
Flare	2	4%
Heater	0	0%
Meter	0	0%
Oil Dump Controller	5	11%
Pneumatic	0	0%
Sales Gas Line	0	0%
Separator	18	39%
Supply Gas Line	0	0%
Tank	5	11%
VOC Pot	2	4%
Water Dump Controller	6	13%
Wellhead	0	0%
Unspecified	0	0%

Leaks By Leak Rate

Range Start	Range End	Leak Count	Leak %
0	0.099	24	52%
0.1	0.199	6	13%
0.2	0.299	8	17%
0.3	0.399	1	2%
0.4	0.499	0	0%
0.5	0.999	4	9%
1	1.999	2	4%
2	9.999	1	2%

Leaks By Type

Type	Leak Count	Leak %
4" Plug on VOC Pot	2	4%
HP Connector	1	2%
HP Flange	1	2%
HP Other	5	11%
HP PRV	0	0%
HP Pump	0	0%
HP Valve	1	2%
LP Connector	1	2%
LP Flange	0	0%
LP Fuel Gas	7	15%
LP Other	0	0%
LP PRV	0	0%
LP Pump	0	0%
LP Regulator	3	7%
LP Seal	2	4%
LP Valve	2	4%
Mizer Nut	8	17%
Mizer Pin	2	4%
Open End	7	15%
Other	1	2%
Thief Hatch	3	7%
Unspecified	0	0%

Leaks Visible From Sky

Visible?	Leak Count	Leak %
Yes	16	35%
No	30	65%
Unknown	0	0%

Questions?

Howard R. Dieter, PE
Vice President, Environmental, Health & Safety
Jonah Energy LLC
707 17th Street, Suite 2700
Denver, CO 80202
howard.dieter@jonahenergy.com