NEW ERA TECHNOLOGY, INC.

The Complete Aerial Surveying, Remote Sensing, and Reporting Solution for the Oil, Gas, and Product Energy Sector

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From the Desk of the President

Update on the Gen V3 Development

The end of a long development road is getting in sight as we are preparing for testing the prototype in the aircraft.

The laboratory tests are nearing conclusion as this newsletter is being assembled. The results have been very encouraging as they have met or exceeded the results from the modeling of the unit through computer analysis.

The size of the unit has also met expectations. A major goal of this program was to develop a unit that was more accurate than the previous generation. This is, of course, the obvious goal of every new development program. With that in mind, our second and third goals were to have the unit be more compact and weigh less than the previous generation. This would allow the unit to be outfitted in smaller more efficient fixed wing aircraft and smaller helicopter making it more affordable to clients of all sizes. The final design has presented us with a more compact sensor that weighs less than 100 lbs. compared to the previous generation which weighs 300 lbs.

In the coming weeks the fixed wing aircraft will be outfitted to receive the sensor and be ready to do the initial flight tests the week of October 19.

Needless to say, we are optimistic and excited to see the initial results. As with all development programs of this type we recognize that will be some hurdles that will still need to be resolved, but the ones that we viewed as the most difficult are now behind us.

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Update from the Customer Solutions Group

New Era Partnership with CLM Construction

New Era is pleased to announce that we have partnered with CLM Construction and now can offer a great solution for construction work or repair for our customers who may need assistance for infrastructure work. CLM offers the following:

- Turnkey solutions to compressor and booster site locations to include all Civil, Mechanical, Electrical and Project Management needs

- Right of Way and Road Maintenance services including vegetation encroachment (Mowing, Tree trimming/removal)
- Pipeline Leak Repair

Notes from the Laboratory

What does Remote Sensing Equipment Measure?

It is very important to understand what a remote sensing instrument measures. Many customers will be familiar with the concept of ppm of gas. This is a fractional unit stating that in a sample of air so many parts per million of that sample is the gas of interest.

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From the Customer Solutions Group

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- Hot Tapping
- Environmental cleanup
- Anomalies Digs
- Custom Fabrication Services such as:
    - Pig Launchers and Receivers
    - Fuel Gas Skids
    - Meter Runs
- Hydro Vac
- Crane and Heavy Equipment Operators on staff

Heat, weld and X-ray tracking

CLM currently operates in Oklahoma, Texas, Colorado, Kansas, Arkansas and New Mexico. However, depending on the scope and size of a project, they have the ability to mobilize just about anywhere.

Notes from the Laboratory

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One ppm means 0.0001% of the air sample was the leaked gas. These are the units for gas sampling sensors such as FID (flame ionization detectors). FIDs have been used in the natural gas industry for decades, and almost everyone is familiar with the unit.

Remote sensing systems do not measure fractional amounts of gas. Instead, they measure the amount of gas along the radiation path to the instrument, most often expressed as ppm-m (i.e. parts per million meter).

One way to think of this is if all the leaked gas was brought to the surface and made pure, then 1 ppm-m of gas would be a layer of gas 1 µm thick.

Note that some remote sensing providers will convert their measurement into ppm by dividing by the distance between the surface/source. This converts the measurement to fractional units (i.e. ppm), and if the path length is long then quoted minimum sensitivities can be tiny, sometimes in ppb (parts per billion). This is extremely disingenuous and deceptive practice.

Many pipeline operators want to understand the sensitivity of a remote sensing system in term of the minimum leak flow rate, usually in units of cfm (i.e. ft^3/min). This is an impossible conversion. Instead, what some remote sensing providers will do is they will provide a number corresponding to the smallest flow rate leak that they "think" they observed and quote that. Again, this is extremely disingenuous and deceptive practice.

Limitations on Airborne Remote Sensing

The sensitivity (and ability) of a surface viewing remote sensing instrument to detect leaks of gas are highly dependent a number of factors, including:

- Surface type (vegetation, soil, moisture, etc.),
- Spatial surface variability,
- Field-of-View (FOV) resolution of measurement,
- Motions of the aircraft,
- Leak rate,
- Leak location,
- Wind speed,
- Atmospheric attenuation,
- Detector dynamic range,

The following sections discuss these sources of error/uncertainty in remote sensing measurement of gas leaks.

A primary consideration of the sensitivity of a remote sensing measurement is the Signal-to-Noise Ratio (SNR). The detection of a leaked gas depends on the signal of the gas (i.e. the absorption of the gas) being larger than the noise on that signal. If the presence of a leaked gas produces a 0.5% reduction in the detected signal, and if the noise in the signal due to the above noise sources is 1% (i.e. SNR = 100), then the "gas signal" cannot be observed. In general, the higher the SNR, the more sensitive the remote sensing measurement.

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Notes from the Laboratory

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Surface Properties

The biggest impact to the sensitivity of surface-viewing remote sensing measurements is the surface. This primarily includes surface types and the spatial variability of the surface.

The reflectivity of the surface is highly dependent on the surface type. For example, in the infrared, the reflectivity of snow is extremely low. This affects the single levels, greatly reducing the SNR. In general, non-vegetation surfaces (i.e. soil, sand, gravel, pavement, shingles, etc.) have much higher reflectivity than vegetation.

Other factors include the type of reflection. Water surfaces produce specular reflections (i.e. like a mirror), with very little energy being reflected back to the aircraft. Similarly, sand, gravel and pavement surfaces often have significant specular reflections. However, due to the random orientation of the surfaces of the grains of these materials, you end up with "spikes" in the signals. This often pushes the detectors beyond their dynamic range and the signals over these surfaces are "garbage". The worst offenders are often metal roofs to buildings (i.e. Sun Glint).

Another factor for vegetation includes the moisture levels. Moist vegetation has significantly less reflectivity. Also, any dew on the vegetation absorbs almost all infrared radiation.

Finally, surfaces types often vary rapidly, down to a spatial scale of sub-meters. Both the GFCR and DIAL techniques attempt to minimize the effects of this variation (i.e. the NETI GFCR measures both REF and COR simultaneously on the same FOV, and DIAL swaps between wavelength rapidly), but these spatial variations in surface do induce noise, reducing the SNR. For GFCRs, the two radiometers will have slight misalignments of the FOV (i.e. do not see exactly the same FOV) and will have a very small parallax (i.e. the two radiometers see the surface from a very slightly different angle).

For DIAL, the laser pulses (i.e. λ_{on} and λ_{off}) will not hit the exact same spot on surface as they are sequential (i.e. do not see exactly the same FOV).

In general, the SNR (and therefore sensitivity) of a remote sensing system can vary by orders of magnitude depending on the surface.

FOV Properties

As noted in the previous section, the motion of the FOV (with the motion of the aircraft) convolved with variations in the surface add noise to the measurement. How these two factors convolve depends on the size of the FOV, the measurement period, the timing of the measurements (i.e. sequential vs simultaneous), and the form of imaging.

The NETI GFCR system is a push-broom imager, meaning that the detector consists of a line of pixels imaged perpendicular to the direction of travel. An image is taken as the aircraft moves forward. This provides the advantage that the entire swath width of the FOV (≈64 m) is imaged continuously. Each individual pixel has a FOV of 2 m on the ground.

DIAL system generally consists of a single laser that is pulsed back and forth between two wavelengths. The spot on the ground is usually small and the pulse is short. If the system is not scanning (i.e. not looking side-to-side, a "center-line" system), then measurements are made in a single line under the aircraft. Gas is only detected if it is blown across the FOV line. If the Dial system is scanning, then the measurement period on any one spot of the ground is very, very, short time, reducing the effective SNR. Note that most other systems on the market are scanners.

Motion of Aircraft

It is nearly impossible to fly a pipeline network and get 100% coverage of the pipeline right-of-way (ROW), due to cross-winds and tight turns. Pilot skill helps a lot, but unless the customer is willing to pay for the flight hours to achieve near 100% coverage, it will never happen. Also, coverage may from time to time be near the edge of the FOV, and if the wind is blowing away from FOV, a leak may be missed. In general, the wider the FOV of the remote sensor, the higher the coverage rate.

Another factor is the altitude at which you fly. Many remote sensors need to fly at low altitudes. At these altitudes, negotiating a tight turn and keeping on-line is much harder. Also, obstacles (such as towers, tall trees, birds, etc.), and aircraft flight characteristics become a significant safety risk.

Leak Properties

Oil and gas asset leaks can vary wildly in rate and location. For underground pipe, leaks can produce point sources of gas above ground, or be diffusely emitted at the ground. Leaks may also come above ground many meters away from buried O&G assets (i.e. migration path of least resistance). Leaks from above ground field assets are much easier to detect, as the gas is immediately in the air, but can be blown away faster.

In the next issue of the newsletter we will continue to look into the limitations of airborne remote sensing and the minimum detectable leak.

New Era Aircraft

The current fleet of aircraft for New Era consists of Cessna 206, Cessna 182, Cessna 172 and Symphony 160. The company is looking to add two more Symphony 160 aircraft to the fleet later this year.

Cessna 206

Symphony 160

With the expected success of the new sensor in 2020 New Era will be adding aviation partners to accommodate the expected growth and demand for the leak indication that will come in the United States and Canada.

Helicopter option where it is most economical for the client.

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Future Newsletters

Issue Dates:

December 2020
March 2021
June 2021

Future contents:

Progress reports on sensor development
Details on navigation system
Business Updates
Technical Updates