Remote Detection and Quantification of Fugitive Emission Sources Using Ambient Measurements

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ABSTRACT

This paper will describe how a recently developed technology to remotely detect and quantify fugitive emissions from ambient measurements has provided opportunities to address fugitive emissions using new and creative approaches. The name of the technology is 'Air Detection and Ranging" (Airdar). The paper will present a Keyera Energy field trial and discuss applications of the Airdar Technology being pursued by Nexen Inc. and Encana Corp.

At the core, Airdar Technology characterizes emission plumes with observations of ambient measurements and can delineate emission plume boundaries, size, concentration profile, and trajectory. Airdar combines information from multiple ambient observation positions to map source locations and emission variability over time. The system can provide 24/7 surveillance of an area with unmanned operation. For large areas the system can cost-effectively provide surveillance for new or changing emission sources.

Airdar has been developed over the past few years with the support of the oil and gas industry, particularly Keyera Energy and an industry group, including Shell Canada, EnCana Corp., Nexen Inc., and TransCanada Corp. This group is presently pursuing an Alberta protocol to claim GHG credits for reductions in fugitive methane emissions. Keyera, a midstream company ("a raw natural gas processor"), and EnCana and Nexen (upstream gas producers) continually look for opportunities to improve their operations and the environment, while increasing value to natural gas producers and adding to their bottom-lines. Accordingly, Keyera did the first of several field trials of the Airdar Technology. Keyera also headed up the protocol group to claim GHG credits for reductions in fugitive methane emissions based on Airdar's capabilities to provide long-term monitoring with complete coverage and quantification. EnCana and Nexen did subsequent field trials and are considering other applications.

Another application discussed in the paper is the Real-time surveillance capabilities of Airdar Technology. Nexen Inc. and EnCana Corp., which have piloted the Airdar Technology, consider Airdar's real-time surveillance capabilities as a very promising solution for identifying and managing fugitive emissions at a facility for changing and emerging sources and accordingly they are considering deploying this capability.

INTRODUCTION

The pattern of air concentrations of a compound in the ambient air is a result of background levels of the compound, nearby sources of the compound, and meteorological conditions affecting the air movement. Generally there has not been success in characterizing fugitive sources using ambient measurements in the oil and gas industry. Back-calculating source strength using ambient measures and dispersion models is one method but, there are serious inherent challenges because it requires either assuming and waiting for ideal conditions, or having accurate information on complex factors such as obstructions, topography, wind strength, and air stability[1, 2]. Some have tried to use inverse-dispersion techniques and open path detectors to quantify sources but found the method limited by the potential for large errors particularly for certain source and sensor configurations[1]. The biggest drawback of these approaches for this application is the need to know the location of the emission source, which is usually not possible when dealing with fugitive emissions in the oil and gas industry. This paper presents field trials of a new technology called "Air Detection and Ranging" (Airdar) that uses proprietary analytical processes to remotely characterize fugitive emissions using point ambient measurements. The robustness of the Airdar Technology's source quantification and characterization capabilities has astounded some of those involved and opened the door to new opportunities for managing fugitive emissions.

Using ambient measurements, the Airdar Technology can remotely detect, locate and quantify fugitive emission sources. This capability is a significant development for the following reasons:

- The nature of fugitive emissions is challenging, and public concern associated with emissions is increasing.
- It can remove the uncertainty around fugitive emissions of methane and provide an equitable basis for trading fugitive methane emission reductions for greenhouse gas (GHG) credits.
- It can make practical the unmanned 24/7 surveillance of gaseous emission sources from industrial facilities.
- It can help to avoid ambient air excedences that occur due to industrial sources by providing actionable information about problematic sources to the facility operators.
- It can provide added value to the many ambient measurements currently being taken.

This paper will present the results of early field trials of the Airdar Technology in locating and quantifying fugitive emissions of methane at a Keyera Energy gas plant. Keyera Energy is a mid-stream energy company in Alberta that has made a practice of supporting innovative technologies to reduce their environmental footprint and increase profitability for the benefit of their customers. As a follow-up to the trials, Keyera has lead an industry group that includes Shell Canada, Nexen Inc., EnCana Corp, and TransCanada Corp. in pursuing a protocol to award greenhouse gas (GHG) credit for reductions in fugitive emissions of methane in Alberta[3]. Presented here is the strategy behind the protocol that would see GHG credit awarded for fugitive methane emission reductions that have been authenticated by Airdar or any other technology that can provide longer-term continuous site-wide quantification of fugitive emissions.

This strategy can also apply to total emissions of methane which include categories from other sources, which may not be considered fugitive. Some examples are intermittent process vents, tankage losses, pneumatically driven controllers or pumps that used natural gas that is vented to atmosphere. Airdar authenticated emission reductions for these categories of sources or due to installation of instrument air or low bleed devices could also qualify for GHG credits.

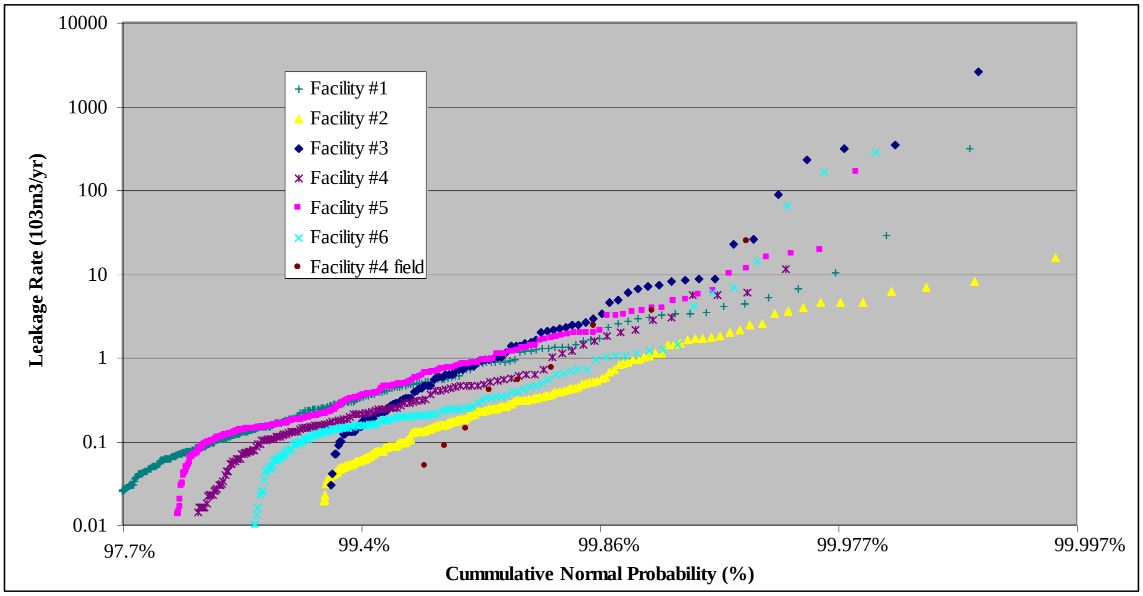
Finally, the paper will describe how the Airdar Technology can operate in a real-time update mode that can provide facility operators with early warning of emerging or changing emission sources. Nexen Inc. and EnCana Corp. are other companies that have piloted the Airdar Technology, and they consider Airdar's real-time surveillance capabilities as a very promising solution for identifying and managing fugitive emissions at a facility for changing and emerging sources, and accordingly they are considering deploying this capability.

FUGITIVE EMISSIONS

It is generally the case that a relatively small number of sources account for the vast majority of the overall fugitive emissions at natural gas facilities. In work done by CETAC-west it was found that, on average, just 10 emission sources out of thousands of potential sources accounted for 80 to 90% of the overall fugitive gas emissions at large gas plants[4]. The plot in Figure 1 is taken from the CETAC-west report cited, and shows the distribution of leaking components at six gas plants. The distributions in Figure 1 represent the extreme tail ends of the huge number of components (up to 20,000 flanges, fittings etc. per site) that were inspected for fugitive emissions. The vertical axis of the figure shows the leakage rate in a log scale (i.e. each axis line is ten time larger than the previous) while the horizontal axis is normal probability (this type of plot in Figure 1 will show elements plotting linearly if they are of the same underlying distribution).

As shown in Figure 1, there are a small number of large leaks (rogues) that account for the vast majority of the overall fugitive emissions at gas plants and they are not of the same underlying distribution as the rest of the leaking components. These rogues are outliers and cannot be predicted based on an analysis of the other leaking components. By extension, facility fugitive emission rates cannot be predicted based on measurements and analysis of suspected leaking components when they are dominated by a few unpredictable rogue outliers. Indeed, large errors will result if emission factors are used on component counts to predict fugitive emission rates. Experience has shown that these random large fugitive emissions regularly go undetected even at facilities that are using the stringent "method 21" protocol that sometimes requires all potential leaking components safely accessible to be visited once every quarter. As the figure shows, proscriptive inspections can be ineffective because all the effort is spent on components in the linear portion of the curve, which are small and disconnected from the important rogue sources. Indeed, experience from both Keyera and EnCana, showed in two field trials that the traditional leak inspection methods commonly employed failed to identify important rogue sources (sometimes due to intermittent emission rates.) In Keyera's case the inspectors were even informed, in advance of the existence of the rogues.

Figure 1: Probability plot of leaking components at six Alberta gas plants[4].



REMOTE DETECTION & QUANTIFICATION BY AMBIENT MEAUSUREMENT

Ambient measurement is common, and is the method used for measuring air concentrations of certain compounds. These measurements are generally used to evaluate the air concentrations of compounds of concern, and are usually compared to an air quality goal or guideline for that compound. The usual reasons for measuring these compounds are concerns related to the associated health or environmental impacts, and to determine if the air in the area is in compliance with guidelines. There is a significant investment in ambient monitoring. Some communities warn their residents if air quality drops below thresholds of concern. Ambient measurements are taken with detection limits similar to the levels of the background concentrations of these compounds, which can be in parts per million (ppm) or even low parts per billion (ppb) levels.

Ambient measurements are generally not used to characterize fugitive sources. In some instances, when there are excedences of guidelines, wind direction has been used to speculate on the direction to a fugitive source, just as a person who smells smoke may look up-wind to locate the fire. But this speculation cannot accurately locate and quantify sources. Airdar's proprietary analytical processes, combined with modern computing power, provide the ability to do this millions of times from multiple locations over an extended period which enables ambient measure to definitively locate and quantify fugitive emission sources. Airdar Technology has broken the code that relates ambient air measurements of concentration and metrological conditions to source location and strength.

The Airdar Technology provides overall site emission rates and for the important sources it provides the location, emission rate and variability over time. There have been five field trials and one controlled study that have proven the accuracy of the method. In field trials significant sources were estimated to within 5 to 7 m of the actual source location. Airdar quantification predictions correlated to the fugitive sources found in the field as well. It was difficult to make comparisons between secondary quantification techniques because fugitive source emission rates in field trials varied substantially over time. Quantification accuracy depends on background level, stability, and wind speed. A controlled study of Airdar's quantification capabilities done in an area with stable background levels found excellent correlation between known and Airdar measured emission rates in the range of 90% agreement.

The limit on the detection range, and size of the detectable source, is determined in the field and subject to local conditions. As a rule, Airdar will be more sensitive when the target gas is less common in the background air. The lower the background level of a compound, the more dilute the plume is that can be distinguished, and likewise, the greater the distance is at which the monitor can identify the compound. A plume from a source is identifiable as long as the concentration of the target compound is significantly above the background levels for that compound.

The controlled study found that plumes of methane in a non-industrial area were distinguishable when the concentration in the plume was 30% above the roughly 1.8 ppm stable background level of methane. So a source that causes a methane plume with a concentration of 2.4 ppm (i.e. 0.6 ppm from source added to 1.8 ppm background) can be characterized. The distance at which that source can be identified depends on wind speed, source size and the number of other sources in the area. In practice, significant sources of methane have been identified several kilometers away. During the EnCana field trial, a hog farm six kilometers from their test site was not surprisingly identified as a methane source. Again the sensitivity and distance capability of Airdar is dependent on background methane level; if the compound has a stable background level in the low ppb range, Airdar could identify much smaller sources at much greater distances. Therefore Airdar could likely be applied to monitor and located sources of more noxious pollutants at greater distances.

The robustness of Airdar's capabilities has encouraged all involved.

A GHG CREDIT STRATEGY

Size of the prize

By their very nature, fugitive emissions are uncertain and so it is impossible to know the true magnitude of the total of emissions across Canada that presently exists. However, an estimate in the "National Inventory Report" [5] produced by Environment Canada in 2007 shows the GHG emissions from fugitives was reported as 66.8 Mt which accounts for 8.8% of Canada's total GHG emissions. This is significant motivation for authenticating reductions of fugitive emissions and getting GHG credits. A reduction of fugitive emissions by half in the Canadian oil and gas industry would result in roughly $500 million annually in additional gas sales (assuming $6/GJ). In addition to the value of the gas, an authenticated reduction of methane emissions would also be valuable as a GHG reduction credit. The authenticated reduction would mean 33.4 Mt CO2 equivalent credit worth roughly an additional $500 million annually (assuming $15/t CO2). This is a significant prize and a true win-win for industry and governments.

Trading emissions for credit

Given the nature of fugitive emissions described above, adequately proving the reduction is the main challenge in trading methane emission reductions for GHG credit. The fugitive emissions are dominated by a small number of unstable sources with unpredictable locations. The only way to establish credit for methane reductions is to know for certain the methane emission exists, know for certain it is eliminated or reduced, and know for certain that it does not reoccur. This certainty requires quantification of the source with a direct measure. Because source locations are unpredictable, surveillance of the entire site is required. Because of variability over time, virtually continuous monitoring is required. Fugitive emission reductions can be proven with certainty by using a direct quantification that provides complete coverage of the site over a sufficient period of time.

In summary, the "credit trading strategy" would provide certain methane emission reductions through monitoring with direct quantification that provides complete coverage of a site with virtually continuous monitoring.

The strategy described above would also benefit facility operators. Critical aspects of the methane emissions issue for facility operations are to track, locate, quantify, and control fugitive sources. Based on this reality, tracking and continuously quantifying the plumes of the overall site emissions and isolating the few dominant sources would provide operators with the information needed to eliminate/reduce the emissions. It would also provide regulators with the needed authentication of emissions occurrence, reduction/elimination, and the confirmation of the ongoing reduction/elimination required to award GHG credits.

Existing technologies were reviewed to see which, if any, could meet the requirements of the strategy described above. This review relied on a recent report called "Review and Update of Methods Used for Air Emissions Leak Detection and Quantification" which was prepared for Technology for Emission Reduction and Eco-Efficiency (TEREE) Steering Committee of Petroleum Technology Alliance Canada (PTAC) by Envirotech Engineering[6]. The technologies in the report were reviewed to determine which could support the strategies of a "direct quantification", "virtually continuous monitoring", and "complete coverage". The results of this review are presented in Table 1 which lists the technologies (referenced back to the table of contents of the Envirotech report) and the compliance to the three components of the strategy. As the table shows, the point source technologies cannot practically provide adequate continuous monitoring or complete coverage components of the strategy. The area source technologies all provide complete coverage but only DIAL and Airdar, provide a direct quantification. DIAL is the only area source technology that can't practically provide continuous monitoring. Airdar can provide all three components of the strategy to certify methane emissions for trading.

Table 1: Summary of technologies that support the credit trading strategy.

Technology	Direct Quantification	Virtually Continuous	Complete Coverage
Point Source Leak Detection Methods.	No	No	No
Point Source Quantification Methods.	Yes	No	No
Area Source Leak Detection and Quantification Technologies.			
1. Differential Absorption LIDAR (DIAL).	Yes	No	Yes
2 Air Detection and Ranging (AIRDAR).	Yes	Yes	Yes
3 Open Path, Path-Integrated Optical Remote Sensing (PI-ORS).	No	Yes	Yes
3.1 Open Path Tunable Diode Laser Absorption Spectroscopy (TDLAS).	No	Yes	Yes
3.2 Open Path Fourier Transform Infrared (FTIR) Spectroscopy.	No	Yes	Yes
3.3 Radial Plume Mapping (RPM).	No	Yes	Yes

The Keyera Energy Experience

Certifying fugitive emission sources including the determination of the locations and quantification of the emission rates within an industrial facility can be a complicated endeavour. Knowing where and when (and how often) to look are important challenges in certifying fugitive emissions because by their nature they are “fugitive” and the location and/or timing of the emissions is usually unknown. Another challenge is that potential sources may be hard to access to check for leakage. Yet another challenge is quantifying the fugitive emission rates of sources because the rates are usually highly variable and/or intermittent, such as in venting situations. Knowing with certainty that an important source has not been missed is the biggest challenge because it is both difficult to accomplish (see above challenges) and critically important to the determination of fugitive emissions at a site. Indeed, the estimated overall fugitive emission rate can be substantially underestimated if one important source is missed at a site.

Keyera Energy worked with some innovators in industry to explore the effectiveness of their novel technologies, particularly at large gas plants. As a midstream company (“a raw natural gas processor”), Keyera continually looks for opportunities to improve their operations and the environment, while increasing value to natural gas producers and adding to their bottom-line. Fugitive emission research in the upstream industry has revealed that at a large facility a handful of “leakers” out of thousands of potential sources are likely to cause the bulk of the methane released. Besides being a potent GHG, the methane has economic value, which for many of the small leaks pays the cost of their repair, while fixing the few larger sources provides net revenue to the owners. With this understanding, Keyera looked into ways of detecting fugitive emissions of methane.

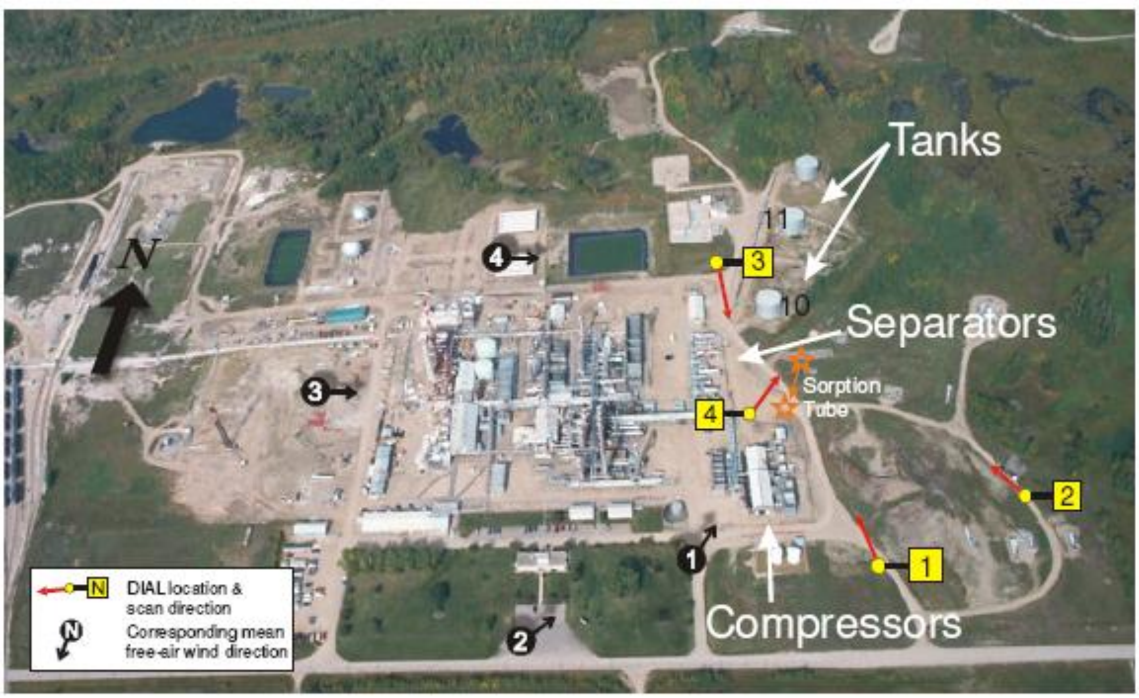
To find fugitive emissions, four technologies were used at a Keyera operated gas plant. Beginning in 2003, a laser survey (called “DIAL”) was done by Spectrasyne Ltd., a United Kingdom company under contract with the Alberta Research Council. DIAL helped to determine a baseline of fugitives across various areas of the plant and was the “stepping stone” to using other technologies. Subsequently in 2005, a new technology called “Air Detection and Ranging (Airdar), developed by an Alberta company, now called Airdar Inc., was prototyped to simplify, reduce cost, and provide long-term monitoring of fugitives. Conventional approaches like sniffing suspected leaking components with handheld monitors and quantifying emission using the bag and stopwatch method were also used.

DIAL

The "DIAL" technology uses Differential Absorption LIDAR ("LIDAR" stands for Laser Imaging Detection and Ranging). The DIAL system projects a plane down wind of suspected emission sources and intercepts the plumes providing a direct quantification of emission rate over a short time period. The DIAL survey provides detailed fugitive emission plume cross-sections and measurements of the total amount of emissions through various parts of a facility. The technique provides a snapshot in time of the fugitive emission profile and is expensive and has limited availability, as the only unit in the world is located in Europe. The "bus" housing the laser optics and electronic equipment takes several personnel to maintain, operate and analyse the data obtained during a survey. DIAL was brought to Canada for demonstration purposes through an initiative by the Alberta Research Council. The survey results helped quantify known fugitive sources, such as hydrocarbon tank vapours and provide Keyera a comparison to other such facilities in industry.

Beginning in 2003, the DIAL technology was deployed at the Keyera gas plant on June 13th to 16th 2003 as shown in the photo in Figure 2 [7]. DIAL determined a baseline of fugitives across various areas of the plant with the results shown in Table 2. The DIAL survey indicated there was an important emitting source or sources at the compressor building.

Figure 2: Air photo of Keyera site showing locations of DIAL equipment deployment [6].



The DIAL technology provided a measure of the overall site emission rate and the emission rate for some of the operational areas for the day of the survey. It did not provide locations of the emitting sources or changes in emitting patterns over time.

Airdar

The Airdar equipment was deployed to the facility between June, 2005 and January, 2006. Airdar uses a unique approach which involves conventional air monitoring instruments drawing samples from multiple locations by means of long lengths of small diameter tubing. These remote sample inlets were positioned at the perimeter of the Keyera facility as shown in photos in Figure 3.

The monitoring trailer (on loan from Alberta Environment) hardware package (used for piloting only) consisted of a flame ionization detector (FID) measuring total hydrocarbons (THC) connected to a valve manifold which allows multiple lines to be sampled in turn in a predetermined sequence. The package included a computer which controlled the valve manifold, and stored data. THC was measured to track plumes and locate and quantify emitting sources. Secondary quantification of the located source was done by bag and stopwatch method with a sample analyzed in a GC to confirm sample composition and methane content (further discussed in bag and stop watch section).

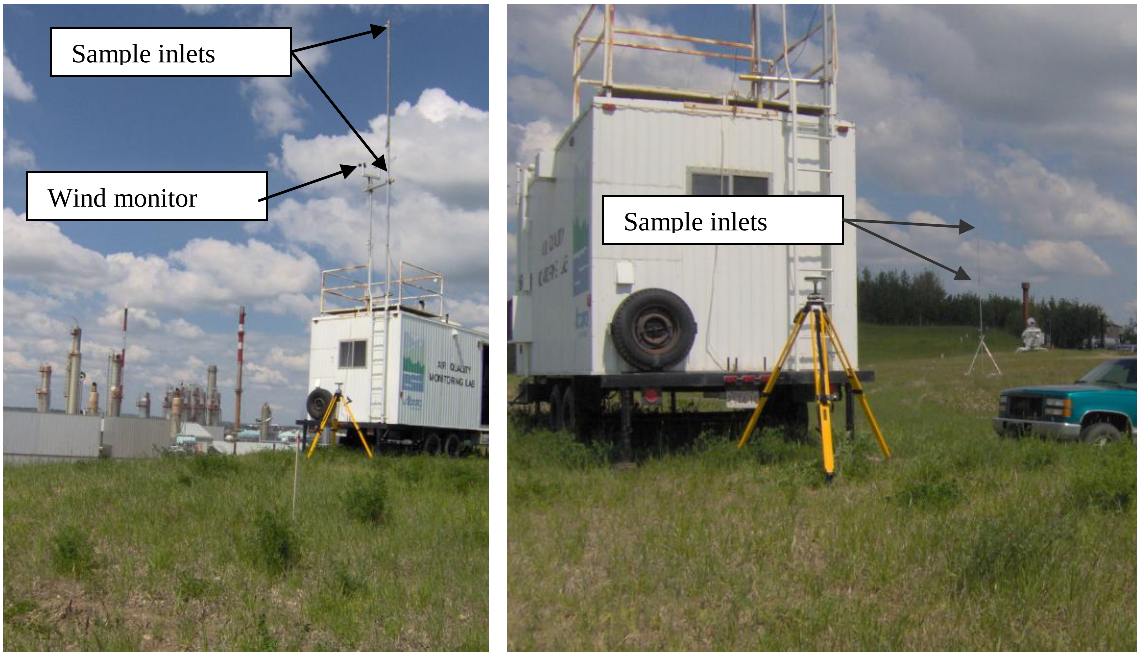
A wind monitor was deployed at the sample trailer as shown in Figure 3 to characterize the wind velocity at the site. The wind data was logged on the computer along with the concentration data.

The data collected at each sampling inlet was analyzed with the proprietary Airdar analytical processes that enable emission plumes to be isolated and characterized. Emission source locations were predicted using triangulation and the Airdar derived plume trajectories from the multiple sampling positions.

Implementation of Airdar provided location and quantification of emission sources based on ambient concentrations of methane and wind measures taken from a few positions around the facility. Variations in emission rates over time were also provided.

Analyzing the data over a couple of months allowed operators to fix sources and provided some unique observations. For example, Airdar was able to improve the understanding of transient hydrocarbon tank vapours and provided a methane emissions “map” of the facility, which indicated the most likely location and size of larger fugitive emission sources, even when they were located off-site. The technique has since been applied at a few other industrial locations providing similar observations and value. In these cases it also assisted in identifying odour events, and their mitigation in complex circumstances.

Figure 3: Air sampling equipment deployed at the Keyera site for Airdar work.



Airdar also determined the location of the dominant emission source at the compressor building shown by a blue square in Figure 4, while the actual location is shown with a red circle. Other sources were also located and quantified including tank vents and a source that was located roughly 1 km offsite in the opposite direction from the plant outside of the study area. The emission sources were quantified based on measured plume boundaries. The variation in the emission rate during the time period was also determined. The average emission rates from the emission sources from June 2005 to January 2006 are show in Table 2 along with the overall site emission rate. The variability in the emission rates of the source at the compressor building is shown in Figure 5. An example of the highly variable emission rate from a large tank venting is show in Figure 6.

The opportunity to prototype the Airdar Technology was attractive to Keyera as it overcame some of the shortfalls and non-accessibility of the DIAL technology.

Figure 4: Plot plan of Keyera gas plant showing the actual and Airdar estimated emission locations at compressor building.

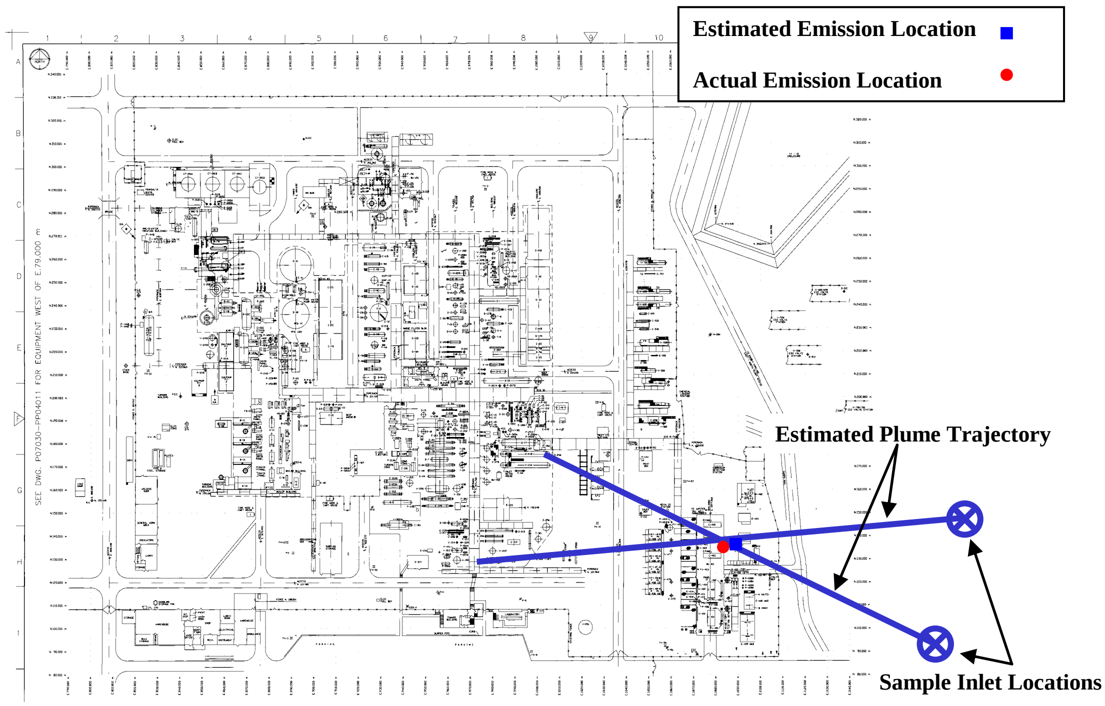


Table 2: Summary of emission measures.

Technology	DIAL	AIRDAR	Traditional Leak detection	Bag and Stopwatch
Compound	methane	THC	THC	THC
units	$10^3 m^3$/yr	$10^3 m^3$/yr	$10^3 m^3$/yr	$10^3 m^3$/yr
date	16-Jun-03	Jun-05 to Jan-06	Fall - 05	Fall - 05
Compressor area	1112	2085	18	965
Separator area	309	79	na	na
Tanks combined	868	522	na	na
Tank 10	-	105	na	na
Tank 11	-	141	na	na
Tank 12	-	276	na	na
Other areas	-	62	na	na
Offsite source	-	40	na	na
Overall plant	2289	2788	na	na

Figure 5: Compressor plume emission rate variability.

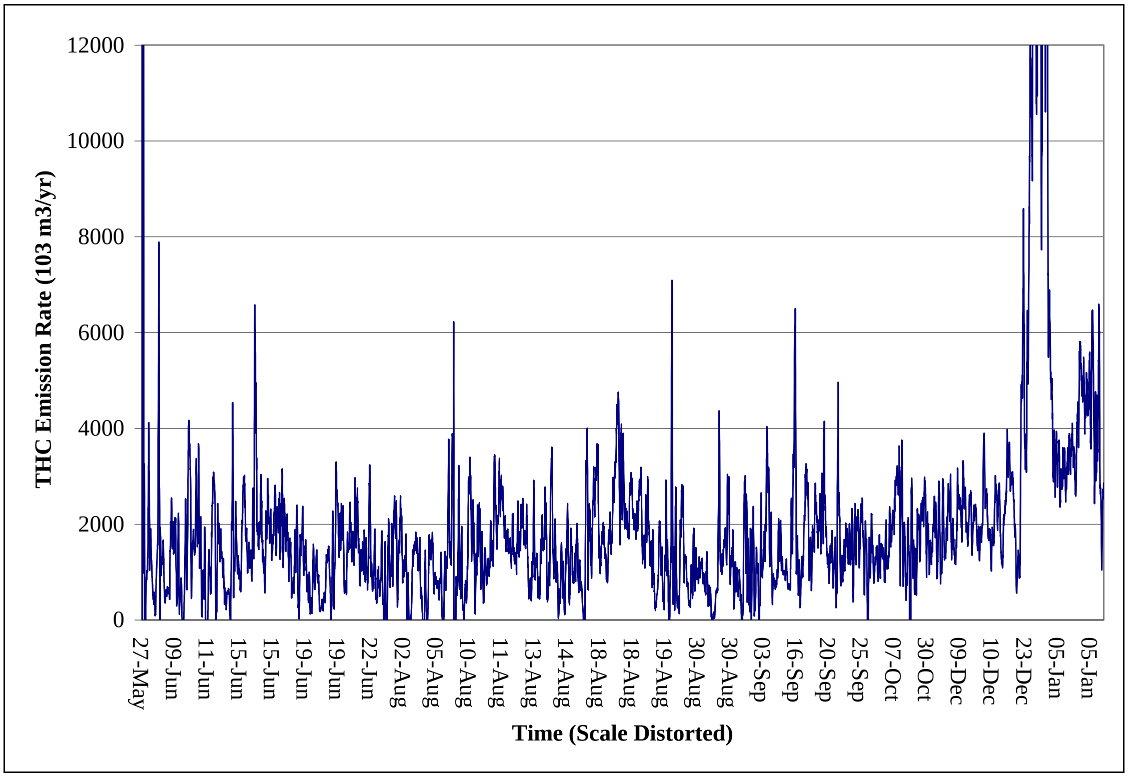
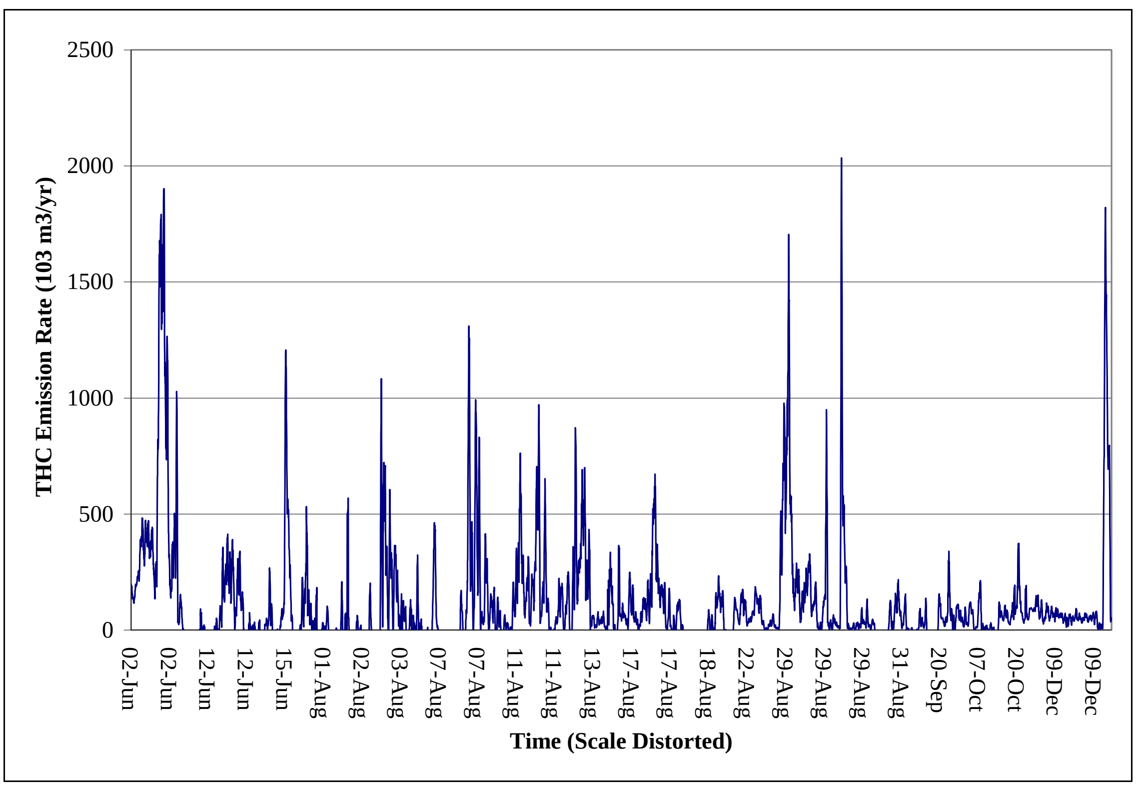


Figure 6: Tank 10 plume emission rate variability.



Traditional Leak Detection (sniffing leaking components)

In pursuing another approach, a third party was used to apply the traditional leak detection technique (by sniffing leaking components) to an area of the plant suspected of an important rogue fugitive emission. This approach did not find the important source that was identified by both DIAL and Airdar Technologies, further explained in the following paragraph.

It was evident from the DIAL 2003 survey and the June Airdar 2005 work that the dominant plume was coming from the compressor building area. Keyera brought in a third party company to conduct a traditional style of leak survey using handheld detectors in this area. The handheld detectors did not find the large leak which demonstrates that it is easy to miss a significant source. As shown in Table 2, missing the significant source will put the emission estimates out by orders of magnitude.

It is important to note that the traditional leak detection techniques & EPA Method 21 application don’t require assessing potential sources above 3 m height above ground or those that aren’t easily reachable. The newer IR camera technology has been useful in this regard, but can’t provide quantification details.

Secondary Quantification

After the rogue source was located and quantified using Airdar a different technique for quantification was employed to determine the degree of consistency between the two methods. Utilizing a man basket for access, a technique of using a bag and stopwatch was used to quantify the emission rate of the source. There was some uncertainty with this technique because the source was so large that even the largest bags available filled in just a few seconds. Multiple runs were performed and results averaged to reduce the uncertainty. The results of this work were consistent with the DIAL and Airdar results.

Secondary quantification of the compressor crankcase vent was conducted using a bag and stopwatch method under Keyera staff assistance and supervision on October 17 2005. A 170 L bag was used and filled in 4.1 and 6.3 seconds on two trials resulting in a calculated emission rate of 1300 and 850 $10^3 m^3$/yr (average 1035 $10^3 m^3$/yr). A sample of the emissions at the crankcase vent was collected in a Tedlar bag in December. It was then analyzed to determine composition by Keyera staff using the Gas Chromatograph at their onsite laboratory. The sample contained 93% THC and 87% methane (note 94% of THC was methane.) The emission size was then calculated to be 905 $10^3 m^3$/yr methane and 965 $10^3 m^3$/yr THC. These results are compared with the others in Table 2.

The agreement between the Airdar measured emission rate and the secondary bag and stopwatch method is difficult to ascertain given the variability in the emission rate. Also, in comparing these two measures it is important to understand that they represent two different sampling durations. The Airdar measure is a multi-month average, while the bag method is a 5 second average. The variability in the emission rate measured by Airdar in Figure 5 indicates levels similar to those measured with the bag and stop watch in roughly the same period.

In summary, Airdar Technology proved effective for the long-term detection, quantification and surveillance of fugitive methane emissions. As a result, a GHG credit trading strategy to accurately determine changes in fugitive emissions is possible through the application of Airdar Technology.

REAL TIME AIRDAR SURVEILLANCE

An obvious extension of Airdar Technology is its capability to provide early warning and location of important new leaks of various types of gas at industrial facilities, pipelines, gathering systems and related infrastructure.

Real-time Airdar surveillance can operate over significant distances (several km,) cover wide areas and provide early detection of new airborne gas emissions. Locations of the new sources are also provided by Airdar. Accordingly, this technology can provide real-time surveillance of various types from industrial facilities, pipelines, gathering systems and related infrastructure. Airdar surveillance would give operators actionable information on emerging emissions sources in their system(s.) With this information, fugitive sources could be remedied quickly and effectively.

Nexen Inc. and EnCana Corp. are companies that have also piloted the Airdar Technology and are currently considering implementing Real-time Airdar at their facilities. Nexen and EnCana recognize the real-time surveillance capabilities of Airdar Technology as a very promising solution for identifying and managing fugitive emissions at facilities with changing and emerging emission sources.

How Real-Time Airdar System Works

The Real-time Airdar surveillance equipment and deployment works as described earlier in the paper. Using the proprietary Airdar analytical processes, Real-time Airdar compares historic readings to produce a simultaneous spatial temporal analysis that is extremely sensitive. The Real-time Airdar analytical processes quickly recognize new sources of the compound that occur anywhere in a large area by detecting the subtle changes in air concentration that they cause. In this way, seemingly insignificant changes in a compound’s concentrations can be quickly recognized as indicators of new or changing emission sources. Their locations and sizes can be determined even at great distances from the monitors.

Currently human noses, which can have a low detection limit for some nuisance compounds, are sometimes the first to detect new emission sources in an area when people encounter undispersed emissions in low wind conditions. The Airdar system can generally monitor with a lower detection limit than the human nose and can identify new sources before operators become aware of them (or before the emissions get bigger.) In addition to alerting the operator to new sources, Real-time Airdar can locate the sources when dispersed emission plumes are observed from more than one position.

The Real-time Airdar system can provide 24/7 surveillance of an area with unmanned operation. The system can cost effectively put a large area under surveillance for new or changing emission sources.

Real-time Airdar tracking of emission plumes is scalable to the size of area to be covered. Surveillance can be focused in a small area, or expanded to cover large regions. Local arrays have multiple sampling inlets located a few hundred meters apart, which draw air back to a single monitor. A local sampling array can locate and quantify sources several kilometers away. Regional arrays are made up of a series of local arrays spaced several kilometers apart simultaneously collecting and sharing information to map emission sources in the broader area which enables surveillance of much larger areas.

CONCLUSION

Remote detection and quantification of fugitive emission sources by applying Airdar analytical processes to ambient measurements have been demonstrated successfully in several field trials. This tracking and quantifying fugitive sources using ambient measurements represents a significant development that may enable new approaches to manage fugitive inventories and identify opportunities for cost effective emission reduction. Keyera Energy, Nexen Inc. and EnCana Corp. are oil and gas industry companies operating in Alberta that have been convinced in field trials of the special capabilities of the Airdar Technology and are pursuing angles of deploying the technology to help manage emissions.

The Keyera example demonstrates that fugitive methane emissions can be authenticated for GHG credit. It was shown that the strategy of monitoring with direct quantification that provides complete coverage of a facility combined with virtually continuous monitoring can justify GHG credit for methane emission reductions. Facilities can potentially use this strategy to authenticate methane emission levels and claim GHG credits for reductions. Keyera leads an industry group that includes EnCana, Shell Canada, Nexen, and Trans Canada in pursuing a protocol that would award credits for fugitive methane emission reductions authenticated with the Airdar Technology.

Establishing this protocol for obtaining GHG credits from methane emission reductions will be a tremendous benefit to all. It will be a self-propelling driver of GHG emission reductions with the potential to deliver a dramatic reduction of the emissions in this area. The protocol, in effect, will put “bounty on methane emissions”, and will incent the reduction of fugitive emissions.

Nexen and EnCana consider Real-time Airdar surveillance as a very promising solution to managing fugitive emissions and are considering deploying it at their facilities.

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