Real-Time Monitoring of Methane Emissions from an Abandoned Natural Gas Well in Western Pennsylvania

RemoteMonitor™ CH4

Model RRM-001

Application Note

V2.00 2-23-2015

Introduction

There are 300,000 to 500,000 abandoned oil and gas wells in Pennsylvania, and some of them might be leaking significant quantities of methane gas according to a new study in the *Proceedings of the National Academy of Sciences*. Orphaned and abandoned oil and gas wells create a natural pathway for methane to migrate from. Researchers found that abandoned wells in Pennsylvania may have contributed 4 to 7 percent of the total man-made methane emissions.

On January 14, 2015 the Obama Administration announced a new goal to cut methane emissions from the oil and gas sector by 40%–45% from 2012 levels by 2025. The "CLIMATE ACTION PLAN - STRATEGY TO REDUCE METHANE EMISSIONS" will address better data collection and measurement techniques to improve our understanding of methane sources and trends, and enable more effective management of opportunities to reduce methane emissions.

Current technologies and methods used to measure and monitor methane emission sources are either ineffective, too expensive, or both. PixController, Inc. has developed a low-cost and effective tool for real-time continuous data monitoring of methane emission sources. The **RemoteMonitor™ CH4** is a wireless telemetry data logging system combining high resolution methane detection with ultra-low power battery power management.

The RemoteMonitor™ CH4 records and transmits methane, barometric pressure, and system data in real-time to a web based cloud server which allows instant access to the data via a standard web browser.

Continuous monitoring is vital for accurate quantification and overall understanding of emissions. Manual sampling has been the primary method for measurement. It is difficult to capture the expected fluctuation in methane concentration with this method; therefore it imposes a serious limitation on accurate quantification.

Pennsylvania has been synonymous with oil, gas and coal extraction. With the ongoing effects of 150 years of oil and gas production infrastructure from decades of unregulated industry the results can cause issues for the new Marcellus shale gas industry (*see Figure 1*).

Century old abandoned natural gas in Western Pennsylvania

Depending on the abandoned well, the casing can be leaky, rotten, or nonexistent. Methane can easily move into natural faults and cracks, following a path toward the surface that can travel through aquifers.

Collecting baseline methane emissions data from these abandoned wells before shale gas drilling operations begin is critical for investigating methane gas migrations cases. The data also provides an accurate measurement of methane emissions from these abandoned wells.

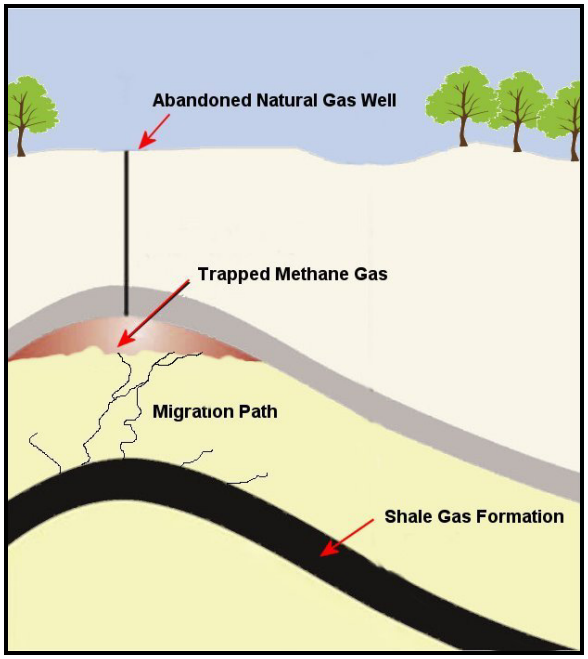


Figure 1

The abandoned gas well chosen for methane emission testing is located in Western Pennsylvania in the heart of where commercial natural gas production began over 130 years ago. The gas well we are monitoring for methane emissions is in a very remote area which does not have power or Internet. The gas well is exposed at ground level containing a 5" well pipe casing with a 2" well bore inside the casing. The depth of the well and actual drilling date is unknown. We are measuring the methane gas emissions from the well casing so we can get an accurate measurement of the integrity of the casing.

Exposed well casing and well bore

Source point to measure gas (well casing)

Field Installation

The RemoteMonitor™ CH4 is a man-portable unit which was designed to be deployed in remote locations. The system is self-contained with an internal battery and integrated solar charging. The system is capable of continuous remote data monitoring over long periods of time without requiring servicing.

Data recording intervals can be adjusted from minutes to days, and can be remotely configured/adjusted through our cloud base web portal. The custom designed methane sensor can detect methane between 0 - 100% LEL with an accuracy of 100 PPM.

Installing RemoteMonitor™ CH4 System

RemoteMonitor™ CH4 System

The system includes an easy to use 5-button menu interface with LCD display for field diagnostics without needing a computer. The display provides the same functionality as a hand-held methane detection unit with a host of other functions. This is useful when deploying the unit to read methane emissions, barometric pressure, and even checking the battery, internal temperature, and cellular connections signal strength.

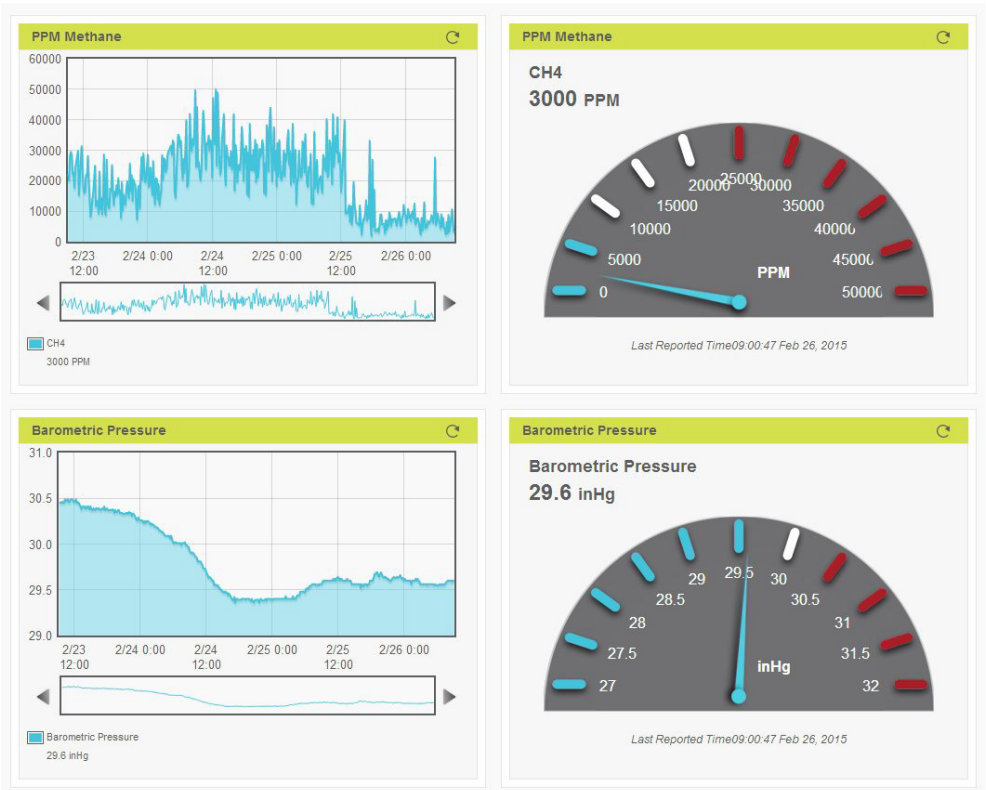
Example of reading on-site methane gas levels

The methane sensor and gas pump are built into the systems NEMA rated weather proof enclosure of the system. A small gas input port at the bottom of the enclosure allows the installer to connect ¼” tubing from the gas port to the methane source.

After the system is powered into data recording mode methane data is read from the sensor and transmitted in real-time to a cloud server on the selected intervals. Along with reading methane gas the system collects barometric pressure, and key system data such as battery level, internal temperature, and cellular signal level.

Barometric pressure data collection is critical in monitoring methane emission and monitoring for methane migration. When barometric pressure rises the methane gas will tend migrate horizontally, however, when barometric pressure drops the methane gas will migrate vertically. Most methane detection systems do not include this vital data.

Data Trending

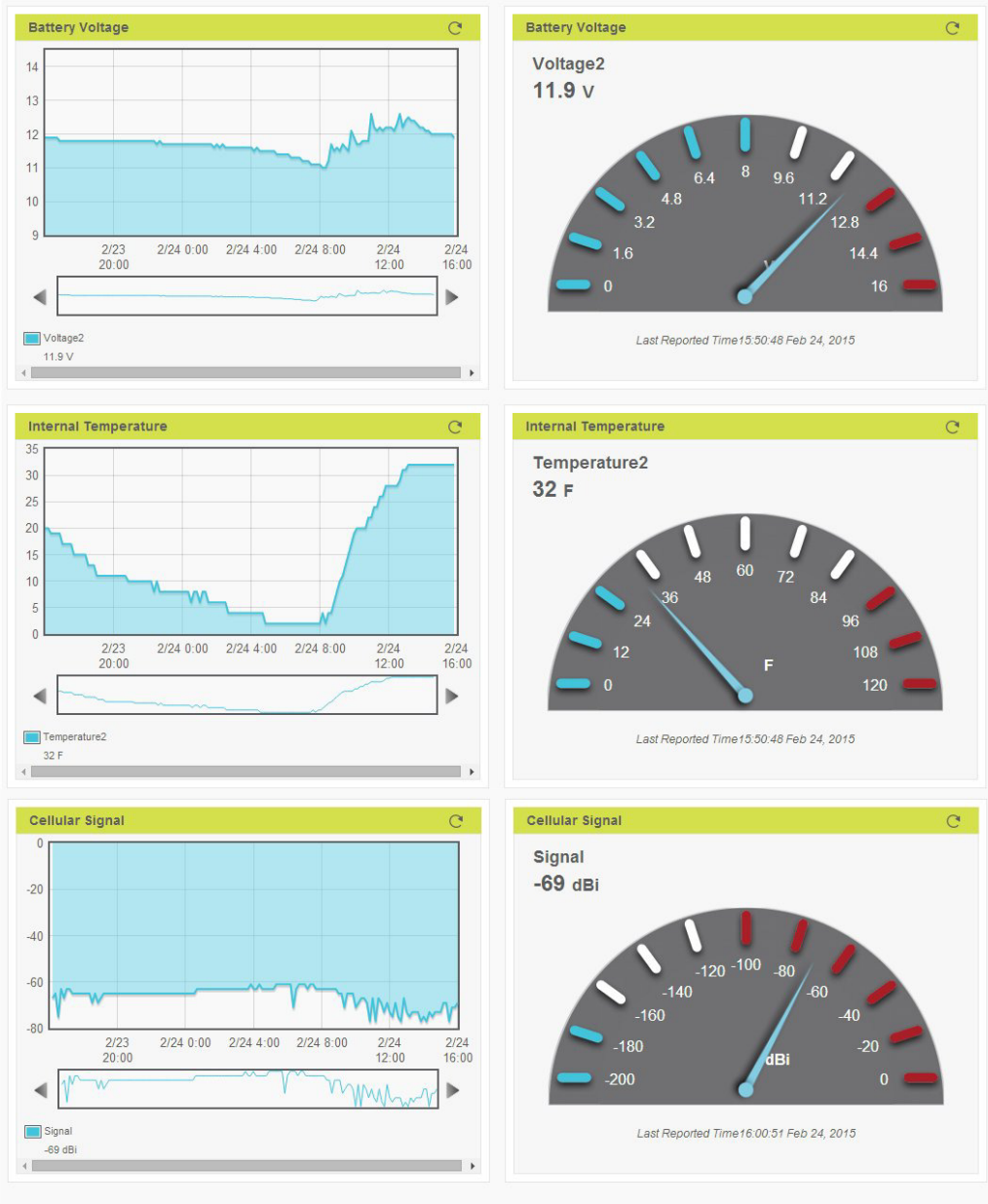


The screen shot from the cloud portal shown above displays the incoming data from the field in real-time. The above graph demonstrates the affect of barometric pressure on methane emissions. An increase of 0.5 inHg in barometric pressure over 24 hours resulted in a 10X decrease in methane levels. This example stresses the importance of continuous data sampling over recording a single sample reading using a hand-held meter in the field by a technician. This example also shows the importance of recording barometric pressure as it relates to methane gas migration. Most hand-held methane detection devices to not record barometric pressure.

System Status Monitoring

Along with recording the sensor data the RemoteMonitor™ CH4 system collects useful system data such as the battery level, internal temperature, and cellular signal strength. The ability to monitor system status information is critical for long-term deployment scenarios.

If the system detects a low battery it will atomically go into a low battery shut down mode and wait for the solar charging to bring the battery back to operation levels. An alarm event is sent to the operator notifying of the shut down. When the battery recovers the system will automatically start up and logging data at which time it notify the operator the system is operational.

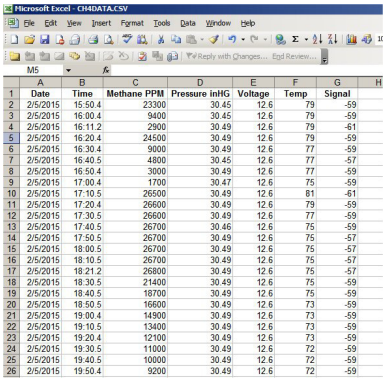


Internal Data Logging

In addition to wireless data transmission to the cloud server the RemoteMonitor™ CH4 saves the data internally on a USB Flash drive. The data is saved in a standard .CSV text file in the following format:

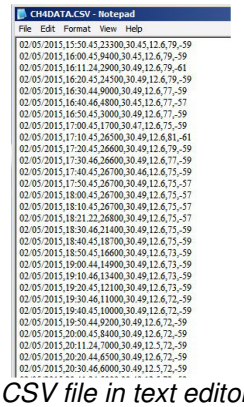
<Date>, <Time>, <Methane PPM>, <Pressure inHG>, <Battery Voltage>, <Internal Temperature>, <Modem Signal Level>

Once a day this data is uploaded to a FTP server for easy remote access/downloading in raw data format remotely. The data is continually appended until the file is deleted by the user at which time a new file is created by the system. The data files can be imported into Microsoft Excel for data analysis or edited by a standard text editor.



	A	B	C	D	E	F	G
1	Date	Time	Methane PPM	Pressure inHG	Voltage	Temp	Signal
2	2/5/2015	15:50.4	23300	30.45	12.6	79	-59
3	2/5/2015	16:00.4	9400	30.45	12.6	79	-59
4	2/5/2015	16:11.2	2900	30.49	12.6	79	-61
5	2/5/2015	16:20.4	24500	30.49	12.6	79	-59
6	2/5/2015	16:30.4	9000	30.49	12.6	77	-59
7	2/5/2015	16:40.5	4800	30.45	12.6	77	-57
8	2/5/2015	16:50.4	3000	30.49	12.6	77	-59
9	2/5/2015	17:00.4	1700	30.47	12.6	75	-59
10	2/5/2015	17:10.5	26600	30.49	12.6	81	-61
11	2/5/2015	17:20.4	26600	30.49	12.6	79	-59
12	2/5/2015	17:30.5	26600	30.49	12.6	77	-59
13	2/5/2015	17:40.5	26700	30.46	12.6	75	-59
14	2/5/2015	17:50.5	26700	30.49	12.6	75	-57
15	2/5/2015	18:00.5	26700	30.49	12.6	75	-57
16	2/5/2015	18:10.5	26700	30.49	12.6	75	-57
17	2/5/2015	18:21.2	26800	30.49	12.6	75	-57
18	2/5/2015	18:30.5	21400	30.49	12.6	75	-59
19	2/5/2015	18:40.5	18700	30.49	12.6	75	-59
20	2/5/2015	18:50.5	16600	30.49	12.6	73	-59
21	2/5/2015	19:00.4	14900	30.49	12.6	73	-59
22	2/5/2015	19:10.5	13400	30.49	12.6	73	-59
23	2/5/2015	19:20.4	12100	30.49	12.6	73	-59
24	2/5/2015	19:30.5	11000	30.49	12.6	72	-59
25	2/5/2015	19:40.5	10000	30.49	12.6	72	-59
26	2/5/2015	19:50.4	9200	30.49	12.6	72	-59

.CSV file in Microsoft Excel



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02/05/2015,16:11.24,2900,30.49,12.6,79,-61
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02/05/2015,20:30.46,6000,30.49,12.5,72,-59
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.CSV file in text editor

Using the charting functions in Microsoft Excel trending data can be easily displayed as shown in Figure 2. The chart below is an actual data set taken over 8-days displaying methane emissions in (red) overlaid with barometric pressure in (blue). The chart further demonstrates how barometric pressure affects methane emissions.

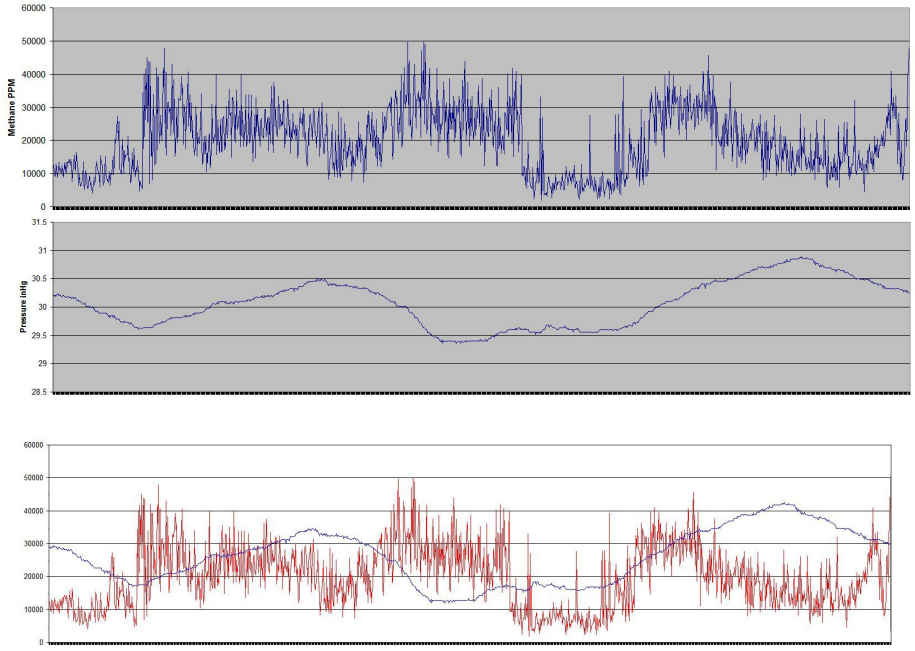

Figure 2