PROJECT CANARY

May 23, 2022

Submitted via http://www.regulations.gov, and email for updates

The Honorable Michael Regan
Administrator
Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

RE: COMMENTS ON THE U.S. ENVIRONMENTAL PROTECTION AGENCY'S PROPOSED RULE, *STANDARDS OF PERFORMANCE FOR NEW, RECONSTRUCTED, AND MODIFIED SOURCES AND EMISSIONS GUIDELINES FOR EXISTING SOURCES: OIL AND NATURAL GAS SECTOR CLIMATE REVIEW*, 86 FED. REG. 63,110 (NOV. 15, 2021) (RIN 2060-AV16)

Dear Administrator Regan:

Project Canary appreciates the opportunity to comment on the U.S. Environmental Protection Agency's (EPA) proposed rule, titled "Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review," 86 Fed. Reg. 63,110 (Nov. 15, 2021). We provide general comments below in this letter, and more detailed comments in a document attached to this letter.

We applaud EPA's proposal for including significant information and for soliciting comment on new technologies that can provide cost-effective ways for the oil and natural gas industry to find and repair potential leaks. One of these breakthrough technologies is continuous monitoring (CM). CM that meets certain technical requirements can serve as an alternative work practice standard to periodic onsite optical gas imaging (OGI), to provide the oil and natural gas industry with an alternative way to comply with EPA's regulations and resolve potential leaks.

Project Canary, an International Environmental Standards (IES) company based in Denver, Colorado, is a mission-driven B-Corporation accountable to a double bottom line of profit and the social good. We believe it is possible to create a financially successful, self-sustaining business that "does well and does good."[1] Our goal is to mitigate climate change by helping the oil and natural gas industry operate on a cleaner, more efficient, more sustainable basis. Our proven solutions provide real-time emissions monitoring and rigorous independent certification of oil and natural gas well sites for responsible operations.[2] Project Canary/IES solutions help energy companies collect, manage, operationalize, and benefit from real-time environmental data.[3]

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[1] Project Canary—Media, Colorado Regulation 7—What You Need To Know About Air Quality Monitoring (Feb. 3, 2021), *available at* https://www.projectcanary.com/colorado-regulation-7-what-you-need-to-know-about-air-quality-monitoring/.
[2] *Id.*
[3] *Id.*

Project Canary is engaged in a partnership with the Payne Institute for Earth Resources at the Colorado School of Mines to develop a collaborative environment for oil and natural gas companies and other external parties to share best practices and insights garnered through CM.[4]

We believe that CM can provide significant benefits, if EPA allows regulated sources to use it to comply with the regulations that it proposed on November 15, 2021, i.e., NSPS OOOOa (with proposed revisions) and OOOOb, and Emissions Guideline OOOOc. As set forth in greater detail in our attached detailed comments, if all new and existing sources chose to use CM as their compliance option, the oil and natural gas industry could **reduce methane emissions by an estimated 370 to 3,700 million tons from 2023 – 2035**. To put that in context, EPA estimates that the new source and existing source regulations, if finalized as proposed, would result in a total reduction of 41 million tons of methane. **Therefore, allowing for the use of CM could enhance methane emission reductions by between 8 and 88 times the projections in the current proposal.**

Based on the significant benefits, we recommend that EPA, in its forthcoming supplemental proposal, propose as an allowable compliance option CM that meets the standards outlined in our attached comments.

We recommend that EPA implement such a compliance option under the rulemaking in both of the following ways:

- As an alternative work practice standard to meet the requirements for detecting fugitive emissions that EPA promulgates for new sources pursuant to Clean Air Act Section 111(b), (h), for the oil and natural gas sector under 40 CFR Part 60, subparts OOOOa and OOOOb; and
- As an acceptable work practice standard that can be selected by states as part of their establishment of standards of performance for existing sources within their jurisdiction in their state plans, pursuant to Clean Air Act Section 111(d), under 40 CFR Part 60, subpart OOOOc.

In the event that EPA does not deem it appropriate in its final rule to approve CM as an alternative work practice standard in the manner described above, Project Canary recommends that EPA, at a minimum, use the supplemental proposal and the final rule to propose and finalize a clear, predictable process to be employed after the rule is finalized to consider applications to use work practice standards under EPA's Alternative Means of Emission Limitation (AMEL) authority pursuant to Clean Air Act Section 111(h)(3). This would include, among other things, establishing binding timelines for EPA to make determinations on AMEL applications. This is critical to enabling the oil and natural gas industry to employ new technologies that reduce emissions in a more effective manner.

In addition, CM can also help companies comply with forthcoming U.S. Securities and Exchange Commission (SEC) requirements related to climate change disclosure. Companies can use CM in assessing whether the natural gas they provide meets sustainability goals, including those to reduce greenhouse gas (GHG) emissions. In short, we believe that CM is an effective tool to harmonize compliance with multiple federal regulations requiring mitigation and disclosure.

[4] *Id.*

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Finally, we appreciate that EPA has acknowledged the need to supplement its initial proposal. As EPA itself recognized in its initial proposal, several critically important issues require more thorough analysis and input. We respectfully request that the scope of the supplemental proposal be as broad as possible, to encourage a fulsome discussion of all the technological issues raised in the initial proposal. In the same vein, we request that the shape of the supplemental proposal be informed by EPA's consideration of the comments that Project Canary and other stakeholders submit on the initial proposal regarding new technologies. Doing so will help EPA assess whether and how to incorporate as allowable compliance options new technologies for oil and natural gas monitoring, such as those pioneered by Project Canary, which provide additional environmental benefits while decreasing costs to regulated businesses.

If you have any questions, please feel free to reach out to David Stewart at (970) 342-5461 or david.stewart@projectcanary.com. We look forward to continuing to work with you and your staff on this important rulemaking.

Anna Scott

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Attached: Detailed Comments by Project Canary

Detailed Comments by Project Canary

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LIST OF ACRONYMS AND ABBREVIATIONS

AER	Alberta Energy Regulator
AVO	Audio, visual, and olfactory
BOE	Barrel of oil equivalent
BSER	Best system of emissions reduction
C.F.R.	Code of Federal Regulations
CH_4	Methane
CM	Continuous monitoring
CO2	Carbon dioxide
CO2e	Carbon dioxide equivalent
EF	Emission factors
EPA	U.S. Environmental Protection Agency
ESG	Environmental, social, and governance
FEAST	Fugitive Emissions Abatement and Simulation Toolkit
Fed. Reg.	Federal Register
GHGRP	Greenhouse gas reporting program
GIS	Geographic Information System
Kg/hr	Kilogram per hour
LDAR	Leak detection and repair
LNG	Liquified natural gas
METEC	Colorado State University Methane Emissions Test and Evaluation Center
MT	Metric ton
QA/QC	Quality assurance/quality control
OGI	Optical Gas Imaging
PPM	Parts per million
PVPFR	Peak vapor pressure flow rate
RSG	Responsibly sourced natural gas
SCF	Standard cubic feet
SEC	U.S. Securities and Exchange Commission
SOP	Standard operating procedures
STEM	Storage tank emissions management
TLDAS	Tunable Laser Diode Absorption Spectroscopy
VOC	Volatile Organic Compound(s)

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I. TOP LINE

Continuous monitoring (CM) has the potential to provide significant methane (CH_4) reduction benefits as well as other pollution reduction benefits. CM will provide at least the same amount of methane (and volatile organic compounds (VOC)) reductions as does periodic OGI. In fact, as we explain below, it will exceed them.

Based on the information in the proposed rule,[5] as well as the information discussed in detail below, we estimate that CM would provide the following methane reductions if implemented at all oil and natural gas wells.[6,7]

Table 1: Reduction in methane emissions from alternative compliance mechanisms relative to quarterly OGI (million short tons of methane)

Type of LDAR	Upper Bound	Lower Bound	Intermittent Values
Bimonthly Flyover	(3,700)	0	1,500
Continuous Monitoring	3,700	370	1,800

Table 2: Reduction in carbon dioxide equivalent emissions from alternative compliance mechanisms relative to quarterly OGI (million short tons of carbon dioxide equivalent)

Type of LDAR	Upper Bound	Lower Bound	Intermittent Values
Bimonthly Flyover	(92,500)	0	37,500
Continuous Monitoring	92,500	9,250	45,000

Table 3: Monetized benefits from alternative compliance mechanisms relative to quarterly OGI (millions of 2019 dollars)

Type of LDAR	Upper Bound	Lower Bound	Intermittent Values
Bimonthly Flyover	($5,260,000)	0	$2,100,000
Continuous Monitoring	$5,260,000	$520,000	$2,600,000

As shown in Table 1, CM would result in increased emissions reductions well above those estimated in the proposal, in an amount between about 370 million short tons of methane to about 3,700 million short tons of methane. To put that in context, according to EPA, all the requirements from its proposed regulations for new sources (subpart OOOOb) and existing sources (subpart OOOOc) together result in a reduction of 41.1 million short tons of methane. Thus, even at the lower bound, **if only 12 percent of**

[5] Between 2023 – 2035, EPA assumes that there will be 2.546 million wells that would be regulated under the OOOOb and OOOOc regulations. *See* EPA, RIA, EPA-452/R-21-003, at 2-25 (Oct. 202).

[6] For convenience, we provide calculations with respect to methane emission reductions. CM offers similar reductions for VOC as well.

[7] As stated previously, this assumes that EPA approves the use of CM as an alternative compliance standard for meeting the requirements for OOOOb and OOOOc and that all sources choose to comply using that method. We are also assuming that repair occurs within the same timeframe regardless of the detection device, so there would be no difference in emissions reductions when comparing the various alternatives with respect to detection (i.e., we do not assume that detection to repair is Y number of days for CM and detection to repair is Z number of days for periodic OGI).

sources choose to implement CM (or if all sources so chose but total leaks were only 12 percent of those estimated), that would double the methane reductions from the regulation.

We have provided a detailed analysis in Appendix C.

II. CONTINUOUS MONITORING (CM) REDUCES MORE EMISSIONS THAN PERIODIC OPTICAL GAS IMAGING (OGI)

One of the areas of general agreement in the oil and natural gas sector is that, according to multiple studies on the topic, fugitive emissions estimates have been underestimated.[8] CM can help provide on-the-ground information that the sector currently lacks. This will, among other things, ensure federal and state decisions in this area are made with the best available information.

This view is supported by not only Project Canary's data, but by analysis using outside and independent sources as well. Project Canary's analysis, using the Fugitive Emissions Abatement and Simulation Toolkit (FEAST),[9] an open-source software tool that compares the efficacy of different leak detection programs, demonstrates that using a CM program for leak detection and repair (LDAR) with the use of a follow-up OGI camera **avoids more than 80 percent of emissions** and reduces emissions by more than 2 times compared with bi-annual surveys. See Appendix A for our assumptions with respect to this modeling.

In sum, CM systems possess multiple advantages. They can:

- Detect methane emissions faster both from the site and specific leak location;
- Capture intermittent emissions that periodic surveys may not;
- Provide rapid verification of repairs; and
- Collect additional temporal information that can help in developing future EPA regulations.

And, as explained in Section V below, EPA has ample discretion under the Clean Air Act both to allow for CM systems as an alternative work practice standard in its new-source regulations and to authorize states to allow existing sources to use CM systems to comply with the standards of performance that states establish for existing sources within their state plans.

[8] Miller, Scot M., Steven C. Wofsy, Anna M. Michalak, Eric A. Kort, Arlyn E. Andrews, Sebastien C. Biraud, Edward J. Dlugokencky, et al. Anthropogenic emissions of methane in the United States, *Proceedings of the National Academy of Sciences* 110, no. 50 (2013): 20018-20022; Alvarez, Ramón A., Daniel Zavala-Araiza, David R. Lyon, David T. Allen, Zachary R. Barkley, Adam R. Brandt, Kenneth J. Davis, et al., Assessment of methane emissions from the US oil and gas supply chain, *Science* 361, no. 6398 (2018): 186-188; Chen, Yuanlei, Evan D. Sherwin, Elena SF Berman, Brian B. Jones, Matthew P. Gordon, Erin B. Wetherley, Eric A. Kort, and Adam R. Brandt, Comprehensive aerial survey quantifies high methane emissions from the New Mexico Permian Basin (2021); Zhang, Yuzhong, Ritesh Gautam, Sudhanshu Pandey, Mark Omara, Joannes D. Maasakkers, Pankaj Sadavarte, David Lyon, et al., Quantifying methane emissions from the largest oil-producing basin in the United States from space, *Science Advances* 6, no. 17 (2020).

[9] Kemp, Chandler E., Arvind P. Ravikumar, and Adam R. Brandt, Comparing natural gas leakage detection technologies using an open-source "virtual gas field" simulator, *Environmental science & technology* 50, no. 8 (2016): 4546-4553.

A. *Detects emissions faster*

Unlike methods that survey infrastructure only a few times per year (e.g., OGI, aircraft methods), CM provides essentially constant surveillance. Although there can potentially be small gaps in information due to adverse environmental conditions, CM systems operate continuously. Instead of only two to six measurements per year, these systems provide *hundreds to millions of measurements per year*.

Because CM systems operate substantially all the time, they detect emissions sooner than non-continuous measurements. This means corrective action can be taken faster, substantially reducing emission duration and total methane and VOC emitted.

This is particularly true with regard to the category of emissions from sources known colloquially as “super emitters.” CM systems are on watch 24 hours a day, 7 days a week, and so are much more likely to detect a super emitter faster than a flyover.

For instance, if a site had a 10 kilogram per hour (kg/hr) emission rate or higher, OGI, flyovers, drones, and/or satellites could detect this. But the technology would have to be operating at the time of the leak in order to detect and correct the emission. A CM would pick up a 10 kg/hr emission within seconds, whereas other technologies would detect this when they were active or aimed directly at the emissions source.

Table 4 below depicts the difference in tons of emissions avoided between the four technologies and clearly demonstrates how CM can find and detect emissions much faster resulting in dramatic potential emissions reductions. This shows just much better CM is than periodic OGI, flyovers, or even daily satellite observations.

Table 4: Theoretical Emissions Avoided Based on Technology[10]

Large Emission Event - Detection Capabilities Expressed in Theoretical Emissions Avoided based on Detection Time

Technology	*Frequency of Inspection*	*Theoretical Emission Rate (kg/hr)*	*Max. Time to Detection (minutes)*	*Emissions Allowed (total kg)*	*Emissions Allowed (total lbs)*	*Emissions Allowed (total tons)*	*Difference (tons of emissions)*
CM	Continuous	10	5	1	2	0.0	
OGI	Quarterly	10	129,600	21,600	48,397	24.2	24.2
Flyover	Bi-monthly	10	86,400	14,400	32,265	16.1	16.1
Sattelite	Daily	10	1,440	240	538	0.3	0.3

Small Emission Event - Detection Capabilities Expressed in Theoretical Emissions Avoided based on Detection Time

Technology	*Frequency of Inspection*	*Theoretical Emission Rate (kg/hr)*	*Max. Time to Detection (minutes)*	*Emissions Allowed (total kg)*	*Emissions Allowed (total lbs)*	*Emissions Allowed (total tons)*	*Difference (tons of emissions)*
CM	Continuous	1	1,440	24	54	0.0	
OGI	Quarterly	1	129,600	2,160	4,840	2.4	2.4
Flyover (1)	Bi-monthly	1	< DL	2,160	4,840	2.4	2.4
Sattelite (1)	Daily	1	< DL	2,160	4,840	2.4	2.4

1 - Low emission rates cannot be detected by flyover or sattelite systems - thus the emission rate deferred back to the OGI inspection requirement

Intermittent Emission Event - Detection Capabilities Expressed in Theoretical Emissions Avoided based on Detection Time

Technology	*Frequency of Inspection*	*Theoretical Emission Rate (kg/hr)*	*Time to Detection (minutes)*	*Emissions Allowed (total kg)*	*Emissions Allowed (total lbs)*	*Emissions Allowed (total tons)*	*Difference (tons of emissions)*
CM	Continuous	5	1,440	120	269	0.1	
OGI (1)	Quarterly	5	129,600	10,800	24,199	12.1	12.0
Flyover (1)	Bi-monthly	5	86,400	7,200	16,132	8.1	7.9
Sattelite (1)	Daily	5	4,320	360	807	0.4	0.3

1 - Intermittent emission rates are difficult to detect by OGI, flyover and sattelites. CMs can detect them fairly easily and instantly thus the emission rates in this chart are conservative

The large emissions event scenario (i.e., larger than 10 kg/hr) presented in Table 4 above demonstrates that, on a single ("super emitter" type) event, CM systems can find the emission source quickly as compared to the intermittent nature of the other technologies. CM also has a clear advantage in detecting *small* emission events, due to CM's sensitivity and continuous functioning. By contrast, flyovers and satellites cannot detect very small emission sources at a given location. OGI cameras may be able to find smaller leaks (i.e., those less than 1 kg/hr), but given the periodic nature of OGI inspections, they will always result in fewer emissions avoided than CM. Intermittent emissions are inherently difficult to detect with non-continuous systems. Therefore, the rates in Table 4 are very conservative. Still, those rates show that CM has a clear advantage over the other technologies.

CM has consistently identified recurring intermittent leaks at numerous facilities at which CM is in operation. The technology is enhancing emissions awareness for site operators and environmental staff. When operators are more aware of emissions events, they are better able to determine if the event is a routine, permissible emissions event, or if it instead is a sign of something that should be assessed and addressed. Even where the emissions event is from a permissible source or at a permissible rate, the operator may choose to develop technological innovations to try and reduce the emissions event voluntarily.

Unlike systems such as EPA Method 21 or OGI, which only detect emissions when directed towards specific equipment component, CM systems continuously detect emissions at site level or larger. They tend to detect the largest emissions quicker, thereby empowering operators to prioritize corrective action.

[10] Table 2 assumes that a leak begins occurring the next hour past inspection and is not discovered until the next inspection attempt. The only variable is the "Time of Detection," and the inspection frequencies were based on the proposed new rule as compared to CM.

B. *Identifies the specific leaking component faster*

Some CM systems are capable of localizing emissions (i.e., identifying with specificity the location of a given emissions event). This means that the CM system does not first require an operator to detect a leak generally and then require another step of determining exactly where that leak is. This allows operators to find the exact location of the leak and repair it faster than other systems.

Table 4 above also identifies a conservative evaluation of the difference in time needed to detect emissions when employing different technologies. Because CM systems are constantly monitoring, they inherently detect emissions much faster. In addition to detecting emissions faster, the Project Canary CM system, and possibly others, identify the approximate source of the leak much faster. CM can detect the area of the site that is leaking using the triangulation (or greater) of CM sensors and Gaussian plume models built in the dashboard. CM systems achieve this because they contain meteorological systems that communicate wind speed and wind direction to the sensors dashboard. This allows for the use of geographic information system (GIS) overlays of the site, which in turn allows the use of machine learning to help CM systems determine the approximate source of the emission. The GIS-based analysis can pinpoint the equipment type that is leaking. This leak source identification process can eliminate or reduce the need to conduct a full OGI survey, because the approximate source of the leak is already identified.

Flyover and satellite-based systems do not have sufficient resolution to specifically pinpoint the source of the leak. These systems only inform the operator of a leak on the location at a point in time; operators using those systems then need to be follow up with an OGI inspection to find and fix the leak.

Of note, CM can additionally determine if emissions are coming from off-site sources using the same triangulation method. By contrast, flyovers and satellites simply provide a large heat map showing where emissions are coming from in a more general sense. Thus, CM allows for a more directed site inspection to find and fix the emission source faster than other methods and mitigate the need for unnecessary OGI inspections that are based on off-site sources.

C. *More likely to capture intermittent emissions*

Numerous peer-reviewed studies have demonstrated that emissions from oil and natural gas operations are intermittent.[11] This effect may be more pronounced with respect to high emissions events: one

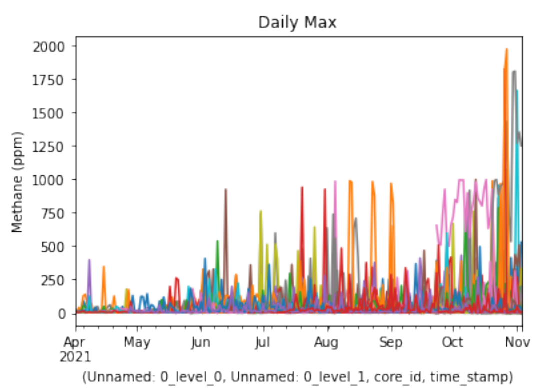
[11] Allen, David T., Felipe J. Cardoso-Saldaña, and Yosuke Kimura, Variability in spatially and temporally resolved emissions and hydrocarbon source fingerprints for oil and gas sources in shale gas production regions, *Environmental science & technology* 51, no. 20 (2017): 12016-12026; Valeria Di Filippo, Ammar Abdilghanie Mohammed, Jianmin (Jimmy) Zhang, Ashraf El-Messidi, Pejman Kazempoor, Nasr Alkadi, Measurement-Based Emission Factors Using BHGE Advanced Methane Sensing Technologies and Analytics (Mar. 31, 2019), Environment and Climate Change Canada (ECCC) Project GCXE18S024. Technical Report; Cardoso-Saldaña, Felipe J. and David T. Allen, Projecting the Temporal Evolution of Methane Emissions from Oil and Gas Production Sites, *Environmental Science & Technology* 54, no. 22 (2020): 14172-14181; Variability observed over time in methane emissions from abandoned oil and gas wells, *International Journal of Greenhouse Gas Control* 100 (2020): 103116;

study[12] found that high emission events are brief and concluded that "short-term sampling is likely to miss them." Additionally, the variability in emissions rate is not caused by changes in production rate: one study found that production variability only accounts for 10 percent of the observed variability in emissions rate.[13]

This variability is due to the underlying engineering of an oil and natural gas production site. Intermittent emissions are the most typical type of emissions detected from locations. This is caused by intermittent pressure fluctuations that are constantly being managed at a production facility. Tank levels and pressures rise and fall, separators dump periodically, slugs and flow rate fluctuations from the wells themselves occur, and seal and valve effectiveness can vary with ambient temperature fluctuations and environmental factors (e.g., insect penetration into sealing surfaces, dust blowing).

The scientific record matches what we have observed at Project Canary. In Figure 1 below, we present daily maximum methane values extracted from over 700 methane sensors deployed across the United States within a few hundred feet of producing oil and natural gas equipment. Our data shows that, while one individual day may present a high emissions event, these levels are seldom observed on the following day or days. This data also demonstrates that sampling on any one individual day may mischaracterize the emissions distribution of a given site, a conclusion that is echoed in the peer-reviewed studies.[14]

Figure 1: daily maximum methane values extracted from over 700 methane sensors deployed across the United States



Tullos, E. E., Stokes, S. N., Cardoso-Saldaña, F. J., Herndon, S. C., Smith, B. J., and Allen, D. T., Use of Short Duration Measurements to Estimate Methane Emissions at Oil and Gas Production Sites. Environmental Science & Technology Letters, 8(6) (2021), 463–467.

[12] Riddick, Stuart N., Denise L. Mauzerall, Michael A. Celia, Mary Kang, and Karl Bandilla, Variability observed over time in methane emissions from abandoned oil and gas wells, *International Journal of Greenhouse Gas Control* 100 (2020): 103-116.

[13] Brantley, Halley L., Eben D. Thoma, William C. Squier, Birnur B. Guven, and David Lyon, Assessment of methane emissions from oil and gas production pads using mobile measurements, *Environmental Science & Technology* 48, no. 24 (2014): 14508-14515.

[14] *See, e.g.*, Allen, David T., Felipe J. Cardoso-Saldaña, and Yosuke Kimura, Variability in spatially and temporally resolved emissions and hydrocarbon source fingerprints for oil and gas sources in shale gas production regions, *Environmental Science & Technology* 51, no. 20 (2017): 12016-12026.

Intermittent emission sources are much more effectively mitigated and managed by CM than by other technologies. *First*, CM offers the highest likelihood of detection.

Second, CM indicates when the event occurred, for how long it occurred, and how large the event was. None of the other technologies can provide these details. When an operator knows the timing, duration, and relative size of an emissions event, the operator can more readily determine the *cause* of the event. Many intermittent events are planned, permitted, allowable events. For example, they can be caused by operational maintenance activities that are allowable and permitted (e.g., well blowdowns, separator cleanouts, hot oiling, thief hatch maintenance, liquids loadouts). Many other intermittent events may not be planned or permitted, but when they are detected, operators are able to mitigate them.

When an operator is armed with a situational awareness on a continuous basis of when and where emissions are occurring, that operator has a much greater ability to find and fix non-routine/allowable emission events. That operator also gains a greater awareness of the types of routine/allowable emission events that it may wish to target for voluntary future emissions reduction projects. Such projects include addition of liquid loadout control systems, well blowdown combustion rather than venting, replacement of higher emitting valves/pneumatics, and chemical programs to prevent waxes/hydrates.

D. Provides rapid verification of leak repair

CM systems inherently verify the efficacy of emission remediation, both immediately and over succeeding days, weeks, and months.

CM systems provide an advantage over all other types of inspections because they can almost immediately provide evidence of the leak being repaired. Not only can CM systems identify the leak faster, but CM systems can also identify faster whether the fix was effective (as the CM system would immediately register no leak instead of needing to wait for another periodic test). CM systems also show the longer-term effectiveness of the repair by continuously showing that a leak is not detected after the repair occurs. This is different than OGI. With OGI, the repair can be verified immediately upon service, but whether the repair is effective over a longer duration cannot be determined. Even a subsequent OGI inspection may or may not detect an emission event if the event is intermittent.

Rapid leak verification is also a service provided automatically by Project Canary's software. Currently, this is implemented by ensuring that a level falls back below a given threshold (e.g., 20 parts per million (ppm)) for a set period of time.

E. Collects temporal variability data

An additional benefit of CM is that it can collect data on the temporal variability of emissions.

To improve the efficiency and effectiveness of methane emission control rules, EPA needs to better understand the temporal variability of emissions. This data can only be provided by CM systems.

The temporal variability in emission rates from oil and natural gas sources is important to understand because, as discussed above, systems that are not continuous are much less likely to detect an intermittent event. Emission rates from oil and natural gas production locations are inherently temporally variable due to numerous variable process conditions. These process conditions have been studied extensively in Colorado under the Colorado Regulation 7 storage tank emissions management (STEM) program. Colorado undertook an effort to understand this temporal nature of emissions from storage tanks. This resulted in peak vapor pressure flow rate (PVPFR) models that were developed by engineering consultants. These complex pressure models are used to calculate threshold conditions that could lead to an emission event from the tank pressure relief valves, thief hatch valves, and other pressure control/equipment on the location. The fundamental idea of STEM modeling is to have a facility design that is capable of handling peak vapor flow rates through the storage tank emissions system. Even with such models, equipment can intermittently or periodically fail to seal, resulting in a temporal emission event. CM systems can detect these temporal events in a much more consistent manner, allowing operators to adjust STEM models or scheduled maintenance events to focus on prevention, rather than simply reacting in a "whack-a-mole" fashion.

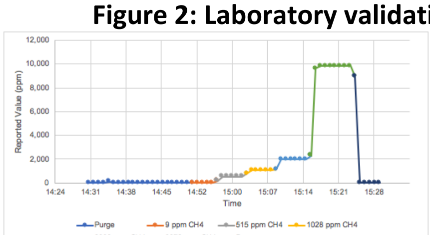
III. CM WORKS

A. Laboratory Validation

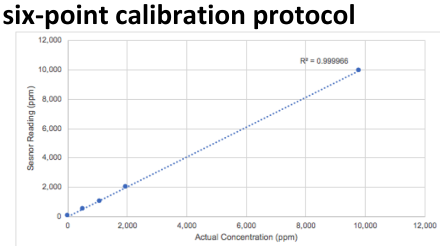
Project Canary's CM system is a Tunable Laser Diode Absorption Spectroscopy (TLDAS) system. This type of system relies on absorption spectroscopy – the measurement of absorption of light of a given frequency – to measure the concentration of a gas. The system is self-contained (that is to say, not an open path laser) and actively aspirated. The principles of sensors using TLDAS principles have been robustly proven (e.g., a search on Google Scholar for the terms "tunable laser diode absorption spectroscopy atmosphere" returns over 45,000 results) and typically exhibit highly linear responses to input signals.

Project Canary conducted laboratory testing in 2020 evaluating the accuracy of methane sensors between 0 and 10,000 ppm in controlled settings. Laboratory results for the Project Canary sensors demonstrate good agreement with released gas, with an R-squared value of 0.99, indicating high agreement between actual and measured concentrations (see Figure 2 below).

Figure 2: Laboratory validation based on a six-point calibration protocol



Time series of methane concentration released using National Institute of Standards and Technology (NIST)-traceable methane gas



Actual versus measured concentration of gas, and corresponding R-squared value or coefficient of determination

B. Colorado State University Methane Emissions Test and Evaluation Center (METEC)

Project Canary's CM system has been tested at the Colorado State University Methane Emissions Test and Evaluation Center (METEC), where METEC simulated leaks of various sizes from oil and natural gas production equipment by releasing methane gas at a known rate. Testing has been conducted in multiple seasons, wind conditions, and leak rates. Several rounds of testing have occurred for methane, specifically in February 2021, August 2021, and September 2021. In all cases, leaks have been detected rapidly (within minutes of any release). These demonstrations prove that CM can rapidly detect leaks.[15] Table 5 below provides the testing conditions under which Project Canary's system was tested and operated.

Table 5: Testing Conditions under which Project Canary has tested controlled releases of methane

	Wind Speed (m/s)	Wind Direction	Pressure (mb)	CH4 (ppm)	Temperature (Degrees Celsius)	Flux (g/s)
Min-Max	0-11	0-359	834-851	0.57-303	(-25.8,33.6)	0,0.10-3.50
					-13- 93 F	0 SCF/minute, 0.4 SCF/minute – 11.12 SCF/minute

C. Colorado Regulation 7

1. Background

Colorado has been one of the first movers on state regulations for the oil and natural gas sector.

On December 18, 2020, the Air Quality Control Commission issued Colorado Regulation 7 (Reg 7), called the "Control of Ozone via Ozone Precursors and Control of Hydrocarbons via Oil and Gas Emissions" (Emissions of Volatile Organic Compounds and Nitrogen Oxides*)*.[16] The rule went into effect on February 14, 2021. The regulation mandates stringent air emissions and monitoring requirements for operators at multiple phases of a well's lifecycle and included allowing CM.[17]

As part of Colorado Reg 7, companies that use CM are allowed to layer CM on top of the existing LDAR/OGI-based frequency; CM is required to be in place on new wells prior to production and through all phases of development until six months after the first date of production.

[15] For further details of the tests, *see* Project Canary, A Quantitative Overview to Continuous Monitoring of Methane Emissions (2021), *available at* https://www.projectcanary.com/wp-content/uploads/2021/09/METEC_ProjectCanary_Sept2021_Quantification_Final.pdf; Project Canary, METEC Testing Results (Aug. 2021), *available at* https://www.projectcanary.com/wp-content/uploads/2021/08/METEC-Project-Canary-Abstract9.pdf.
[16] Project Canary—Media, Colorado Regulation 7—What You Need To Know About Air Quality Monitoring (Feb. 3, 2021), *available at* https://www.projectcanary.com/colorado-regulation-7-what-you-need-to-know-about-air-quality-monitoring/.
[17] *Id.*

Operators are pursuing the equivalency option because for some operators it may be more cost-effective than enhanced LDAR/OGI inspection frequency. The equivalency option may not only be more cost-effective – it also adds an additional layer of risk management for a company. The most recent rulemaking in Colorado estimated costs for OGI at $105.47/metric ton (MT) carbon dioxide equivalent (CO2*e*). (We and others in the industry believe that this cost estimate is artificially low.[18]) These costs include the OGI cameras, technician training, vehicles, and time to conduct the inspection and then program documentation resources. OGI camera inspections are very manually intensive events that require data to be input into systems (because there is no interface between a camera detection and a system for tracking the events). This makes it difficult to develop trends, track corrective actions, and develop proactive programs aimed at *prevention* rather than simply detect-and-fix.

Low-cost, high-fidelity sensors like those that Project Canary uses, when combined with a machine learning automated dashboard, can find and document the leak types much more effectively than OGI-based systems. As shown above, CM will detect emissions much more quickly than even greatly enhanced frequency of inspections. Consistently low detection limits, combined with the continuous nature of the inspection, will result in an operator finding more of the smaller leaks and all of the large intermittent leaks. The combination of the sensors with the cloud reporting dashboard system allows operators to use their OGI camera teams for pinpointing known (through the use of CM) leaks rather than trying to find them through less efficient or less accurate methods. Efficiencies are gained rapidly with the use of CM. Not only can leaks be found faster, but corrective actions can be put into place and documented through the product dashboard. Then, the effectiveness of the mitigation is automatically detected and documented through the CM system.

The list of operators in Colorado that are using CM is rapidly expanding, for several reasons. *First*, CM complies with the new Regulation 7 Pre-Production Monitoring rule. The rule is particularly non-prescriptive on the sensor type, sensor placement, and response requirements. But these issues are in the process of being iteratively resolved through hands-on experience between the operators and the regulators. *Second*, several local governments with oil and natural gas development within their boundaries are seeking faster and more reliable means to detect emissions. CM systems are widely seen as more effective by these local governments (Broomfield, Aurora, Erie, Weld County, and Dacono). These local governments are most concerned with detecting acute events that could lead to a public health risk. The Project Canary CM system is particularly adept at addressing this concern.

2. Implementation of Colorado Reg 7

Monitoring Plans

For Colorado to approve a CM technology under Reg 7, operators must submit to the state a monitoring

[18] Robyn Wille, Chief Strategy Officer & Stefanie Rucker, Office of Innovations in Planning, Colorado Department of Public Health & Environment, Air Pollution Control Division, Regs 7 and 22 AQCC Hearing – APCD Rebuttal Regulations 7 and 22 (Dec. 17, 2021).

plan detailing the technology they've selected, any validation of the technology, and other details.[19]

Alerting

Colorado Reg 7 proposed rule changes makes note of the fact that CM systems typically have a lower detection threshold.[20] While some have raised concerns that every emission event would trigger an OGI survey, that is contrary to Project Canary's experience in Colorado, where we have implemented CM for several months now. We have eliminated this concern by having three levels of alert, each of which necessitates a different response. Levels are determined by the intensity and longevity of the emission event.

These alert levels and responses vary by company, but the standard operating procedure (SOP) provided in Appendix B and the explanation below provide a basic understanding on how companies respond to and minimize over reaction to alerts. In essence, operators use a decision tree to determine what action needs to follow a detection. Typically, this is part of the implementation period and the frequency of responding to an alarm decreases dramatically over the course of the first few months of monitoring. We have also provided examples of the Project Canary dashboard in Figures 3 and 4 below.

Project Canary also generates summary reports monthly containing the range of emissions seen, any events that were noted, and documentation about those events. This can either be automatically sent to the state or automatically generated and sent to the operator for review.

Alert Type 1 – High concentration event as defined by the company (typically greater than 10 ppm methane above background concentration) over a short period of time (about less than one hour) or longer.

- Operator response: Review view automation records and maintenance schedules (typically requires 5 minutes or less to check) to determine if this is a permitted / allowable emissions event caused by operational maintenance.
    - *If yes*: Document reason for event; no further action needed if alert levels drop back to typical site emissions concentrations.
    - *If no*: investigate immediately using lease operators and audio-visual and olfactory observation, elevate to OGI as needed. Repair issue and document.

Alert Type 2 – Lower concentration event as defined by the company (typically set between about 5 – 10 ppm methane above background concentration) that is continuous.

- Operator response: Conduct a directed OGI inspection using the source attribution portion of the software to narrow source of emission.
    - Find and fix leak; and
    - Document.

[19] Austin Heitmann, Montrose Environmental, What Colorado's Regulation 7 Continuous Monitoring Reporting Requirements Mean for Your Team (June 14, 2021), *available at* https://montrose-env.com/blog/colorado-regulation-7-continuous-monitoring-reporting-requirements/.

[20] Proposed changes to 5 CCR 1001-9, *available at* https://drive.google.com/file/d/1JXzWUuPedxqHVCqiU6BdK3GJn_Z0x50X/view.

Alert Type 3 – Very low concentration event as defined by the company (typically set at 1 – 2 ppm methane above background concentration) over a 24 period or longer.

- Operator response: Check for off-site sources. Review view automation records and maintenance schedules to determine if this is a permitted/allowable emissions event caused by operational maintenance.
- *If yes*:
  - Document reason for event; no further action needed if alert levels drop back to typical site emissions concentrations.
- *If no*:
  - Investigate during the next scheduled OGI inspection;
  - Repair issue and document; and
  - If no leaks found, consider adjusting background concentration.

Alert Type 4 – High or low concentration event as defined by the company that is intermittent.

- Operator response: Review automation records and maintenance schedules to determine if this is a permitted/allowable emissions event caused by operational maintenance.
- *If yes*:
  - Document reason for event; no further action needed as long as alert levels drop and reverts back to typical site emissions concentrations.
- *If no*:
  - Evaluate the event over time and determine if it correlates to an operations event or environmental influence;
  - Use the source attribution dashboard to determine where the leak is coming from. Elevate to a longer term OGI as needed; and
  - Repair issue and document.

Figure 3: Example of Portion of Project Canary Dashboard

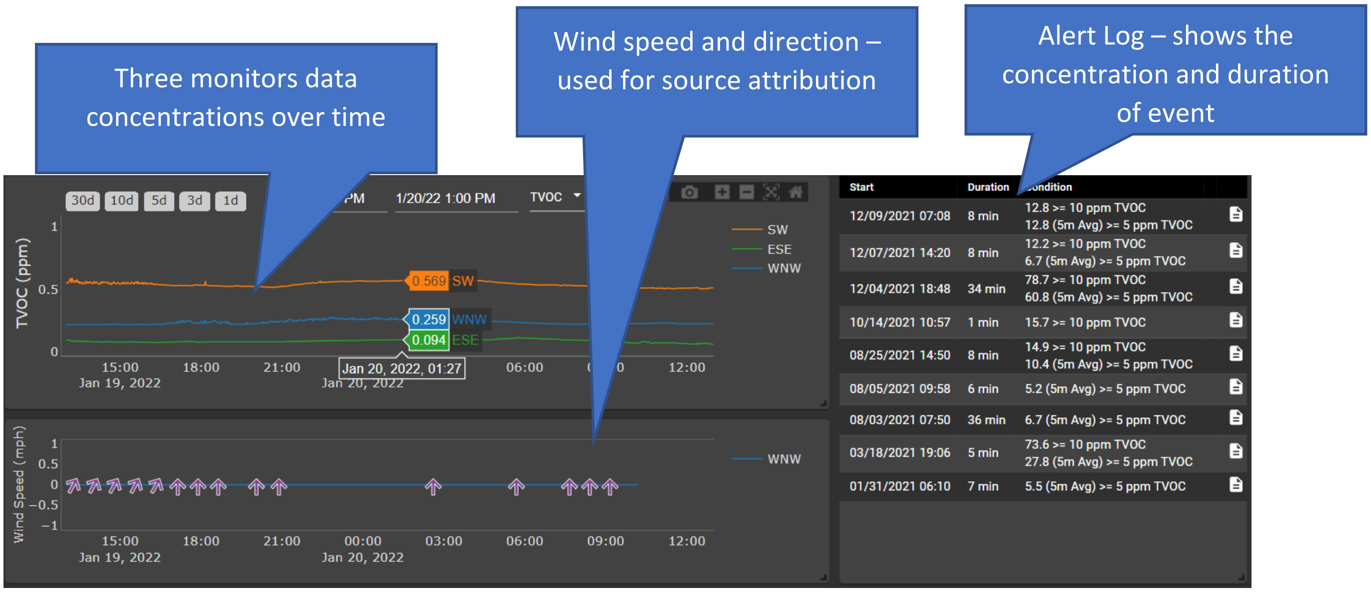
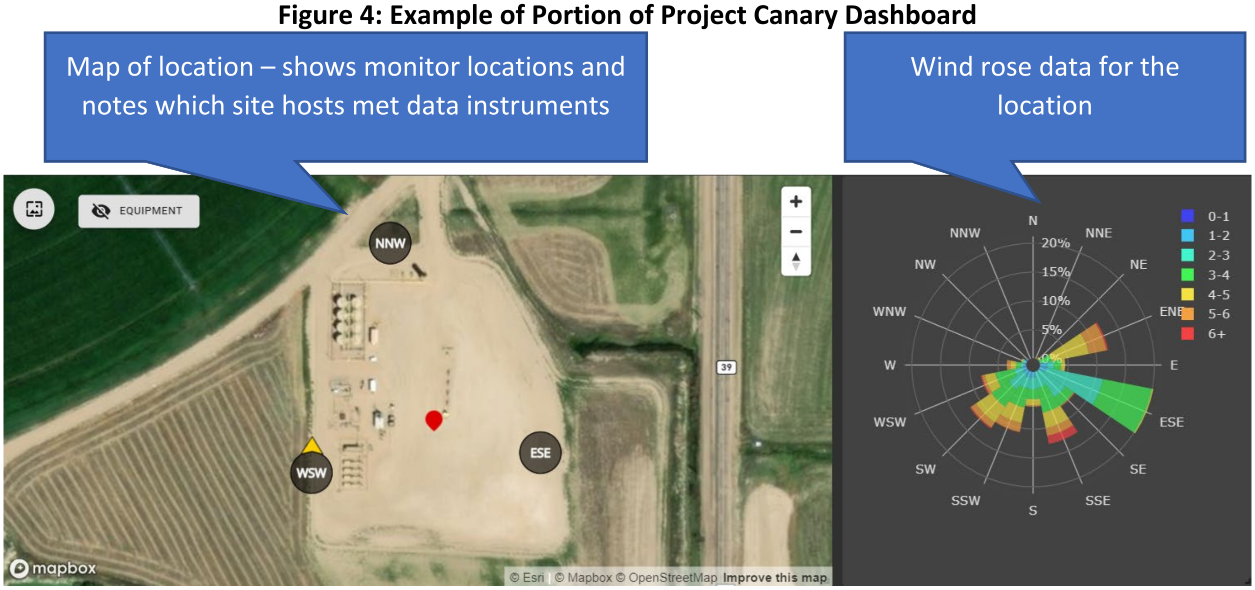


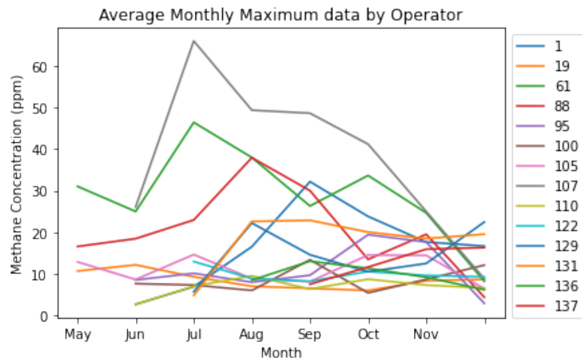
Figure 4: Example of Portion of Project Canary Dashboard



D. *Oil and natural gas industry*

Project Canary's system has been tested and proven effective at various sites around the country. Operators who implement CM have seen decreases in observed methane concentrations. In Figure 5 below, we show the monthly average of daily maximum methane data across operators who have implemented Project Canary's technology for several months (that is, the average highest value an operator sees in any given day, aggregated by month). This data can be understood to indicate the average day's highest possible value; larger concentration values indicate larger emission events, all things else being equal (factors such as production or weather are not accounted for in this figure). The below figure shows decreasing emissions for many operators, demonstrating that many operators see emissions reduce over time.

Figure 5: Average Monthly Maximum Data by Operator



E. Alberta Energy Regulator

The Alberta Energy Regulator (AER) oversees the largest producer of oil and natural gas in Canada.[21] AER, according to its description of its mission and functions: reviews applications and makes decisions on tens of thousands of proposed energy developments each year; oversees all aspects of energy resource activities in accordance with government policies; regularly inspects energy activities to ensure that all applicable requirements are met; penalizes companies that fail to comply with AER requirements; holds hearings on proposed energy developments; and continuously looks for way to improve its regulatory system so that it is efficient and adaptive to the global market and technology changes that affect the industry and demonstrates Alberta's competitiveness.[22]

The Alberta Energy Regulator has approved the use of CM for leak detection and repair for the oil and natural gas industry.[23]

IV. PROJECT CANARY'S IMPLEMENTATION OF CM

While the CM technology discussed above is better than periodic walk-around OGI, there are certain requirements that may be necessary to ensure that EPA's regulatory standards are met. Our implementation shows that CM technology can provide reliable, consistent, and accurate data that is superior to the current work practice standards proposed by EPA.

[21] How does the AER regulate energy development in Alberta? Alberta Energy Regulator, *available at* https://www.aer.ca/protecting-what-matters/holding-industry-accountable/how-does-the-AER-regulate-energy-development-in-alberta.
[22] *Id.*
[23] https://www.newswire.ca/news-releases/qube-technologies-receives-first-regulatory-approval-in-north-america-for-continuous-methane-monitoring-890321571.html

We do not believe that prescriptive requirements are necessary for this rulemaking. Rather, we believe that **performance-based standards to govern the operation of CM systems meet EPA's intent in this proposed rulemaking, as well as regulatory and statutory requirements**. **We believe that EPA, if necessary, can develop implementation guidance documents in the future that could provide acceptable prescriptive requirements as a means of meeting those performance-based standards for CM implementation**. To assist in establishing the performance-based standards that we believe are appropriate for this rulemaking, in this section, we detail how Project Canary implements CM to meet high standards.

A. Background

Project Canary technology is sensitive enough to detect levels down to 0.5 – 1.0 ppm. The 10 kg/hr methane screening threshold is much higher. In terms of kg/hr emission rates, we have comfortably calculated leak rates less than 1 kg/hr, and with advance artificial intelligence/machine learning (AI/ML) we believe that we can detect actionable events less than 0.5 kg/hr.

Project Canary's CM system has been implemented across the United States, with roughly a thousand units having been deployed through dozens of unique accounts. Project Canary is heavily involved in the CM market with roughly a thousand of our proprietary devices being deployed through dozens of unique accounts. Our clients range the upstream and midstream segments in multiple basins across the United States (Marcellus, Utica, Haynesville, Barnett, Eagle Ford, Permian, Piceance, Denver-Julesburg, Green River, and Bakken), Canada and the United Kingdom. With the growth of responsibly sourced gas anticipated to exceed 30 to 40 percent of the United States gas market in the United States in 2022, driven by demand from LNG and utility customers, we see an increasing need for deployment of our CM devices

As stated above, the implementation of Colorado Reg 7 allows for the use of CM. Under Colorado Reg 7, the frequencies of OGI inspections decreases over time, from an initial frequency of once every six months. The idea underlying this policy is that CM data can be compared to the OGI data for leaks found. There will be times when OGI inspection is not being conducted and the CM detects an emission. These events would be categorized as upside to the CM program and leak rates would be shown to be greatly reduced due to the continuous nature of monitoring. As confidence in the CM system grows, routine LDAR inspection frequencies could be lessened and OGI would be used more for pinpointing the leak.

B. Source-specific requirements for when CM can be used

Project Canary sensors are rated for temperatures ranging from 10 to 65 degrees Celsius (14 to 150 degrees Fahrenheit), though we have confirmed operation through controlled testing at METEC for temperatures outside this range, in particular for colder temperatures.

The Project Canary technology is powered by solar panels and requires cellular service to upload the data in the cloud. The back-up battery and data systems provide the ability to operate without sun for short periods of time and there is a procedure to backup data into the database until cellular service coverage is available. **We have found that our technology can work in every oil and natural gas basin**.

We believe that a performance-based approach that requires functionality to be provided for a certain amount of time each year or month is sufficient to comply with EPA's requirements in this rulemaking and the intent of its proposal. We believe that a standard does not need to be particularly high for CM to be more effective.

C. How often CM must be operational

Project Canary strives to have CM be operational 100 percent of the time. However, there are times where lack of cellular connection, lack of sun for long periods of time, or instrument malfunctions can impact functionality. We routinely see monitor uptimes in excess of 90 percent of the time. A single monitor is sufficient to find leaks if it is aligned with the correct wind direction. Given that we typically install three monitors at a location, the probability of having a total site outage is extremely low. As long as one monitor is operational, we can determine whether a leak is potentially coming from the site and can be checked when the other monitors are fixed.

Our dashboard system has a "flagging "approach to indicate whether a monitor is not operational or working improperly. While we recommend that the monitor be fixed as soon as possible (considering technical feasibility issues), our system will still detect leaks faster than any sort of periodic monitoring system.

D. Necessary training for use of CM

One of the main benefits from CM is that there are no required walking paths or training for the use of the equipment. Unlike with other detection technologies, there is essentially no wrong way to "hold" a CM, minimizing the risk of user error. As long as the CM is appropriately maintained (see discussion on this below), there is no required training necessary.

Project Canary's implementation of CM is a service offering, meaning that Project Canary handles the installation and maintenance of the technology. Our customers then interact mostly with our software that visualizes our data, rather than needing to touch monitors themselves. We offer training on our software dashboard to all new clients to ensure that users can understand how to access data, as well as set alerts for customers so that they are promptly notified when emissions are detected.

Due to these reasons, we believe it would be unnecessary and inappropriate to apply training requirements for CM systems like those proposed to be required for other detection systems under 40 CFR Part 60, Appendix K.

E. Recordkeeping and reporting requirements

Project Canary's proprietary dashboard logs data and can provide regular reports that can meet EPA's requirements. As a software offering, we are capable of automatically generating reports for operators. Due to this capability, we do not believe that companies using Project Canary's technology would need to use different reporting and recordkeeping requirements than those currently required under 40 CFR 5420a.

F. Recommended repair requirements for leaks

Since CM systems are always running, they can detect leaks throughout the year at various levels. At this stage in the development of CM technology, we believe that the requirements for how quickly a repair must be completed after a leak is detected should be the same as those required for periodic OGI. Because CM systems detect leaks faster, they are able to fix the leaks faster than a periodic OGI review would.

As stated above, CM provides instantaneous responses on whether a leak has been properly repaired.

G. Quality Assurance/Quality Control (QA/QC) requirements

We support QA/QC requirements for the technology required to operate CM. However, as there are multiple forms of CM, requirements should be performance-based rather than prescriptive.

QA/QC requirements should be determined by the sensor manufacturer. These more detailed requirements could be built out over time by EPA. But, given the variety of technologies that meet CM, it would be premature at this time for EPA to promulgate specific QA/QC requirements. Overly prescriptive requirements at this stage in the development of new and promising technology may stifle the full emergence of that technology.

H. Case study of implementation of PC technology

Multiple operators first started implementing different CM systems over two years ago. There have been several key learnings in the implementation process that we believe can assist in the development of performance-based standards described above. In addition, we are providing in Appendix B an example of an SOP that has been used as a template for multiple different operators. (This SOP is being provided as an example and should ***<u>not</u>*** be used in its entirety as regulatory text, as the SOP will vary depending on the operator and their specific needs.)

1. <u>Selection of the monitoring technology</u>

The first part of the implementation process was choosing the correct technology to use. Colorado operators have several potential sensors and companies to choose from. The majority have chosen Project Canary due to our low-cost, high-sensitivity, multi- type ability, availability, and ease of installation and operation. Project Canary's technology have sensors for both VOC and methane, is easy to install, and is able to fit on location, if needed.

2. Monitor factor calibration and set-up

Project Canary utilizes a three-point calibration system (low, medium, and high height) that covers the range of potential leaks in the field. This three-point calibration system is in line with EPA's QA/QC requirements for continuous emissions monitoring.

As part of the initial calibration and set-up, we conduct bump tests[24] to ensure that the sensors are responding well. Then, during the initial days of operation, we identify any potential issues by comparing monitors to each other and calibrating them, taking into consideration the standard background methane concentration for the area.

3. Siting

Siting is important to the CM system's ability to detect VOC and methane emissions. The site must have a cellular data connection and solar radiation or another power supply, as described in greater detail above. The monitors are usually set between 4 to 6 feet above ground surface, as METEC has shown that this range of heights is acceptable for picking up higher elevation leaks and most standard production equipment on location.[25]

Project Canary's current recommendation is that one monitor per acre be placed on site. The typical configuration is three monitors on a three-acre well pad. More monitors would be added for larger well pad sites or midstream applications.

Using publicly available wind data from the nearest representative area, monitors are placed upwind and downwind of the predominant wind direction. As Project Canary is able to collect meteorological data to optimize sensor placement, the monitors can be moved later if necessary for optimization.

There are other factors that are considered in the siting of the monitors, including locating monitors where they pose no risk of harm to employees or the public, placement of generators, and placement of other emission sources.

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[24] A bump test is a qualitative function check in which a challenge gas is passed over the sensor(s) at a concentration and exposure time sufficient to activate all alarm settings. The purpose of this check is to confirm that gas can get to the sensor(s) and that all the instrument's alarms are functional. The bump test or function check does not provide a measure of the instrument's accuracy. *See* Calibrating and Testing Direct-Reading Portable Gas Monitors, Safety and Health Informational Bulletin, United States Department of Labor, Occupational Safety and Health Administration, *available at* https://www.osha.gov/publications/shib093013.

[25] Project Canary, METEC Testing Results (Aug. 2021), *available at* https://www.projectcanary.com/wp-content/uploads/2021/08/METEC-Project-Canary-Abstract9.pdf.

4. The initial period: first 60 days

During the first 60 days, we establish various alarm levels and work with the operator to resolve any anomalies detected.

We also analyze the alarm thresholds and generally set the various alarm thresholds that signify different types of leaks based on the alerting system discussed in the discussion of the implementation of Colorado Reg 7 above.

5. Operations: 60 days and beyond

After the first 60 days of monitoring, we analyze the data to determine whether there are any potential improvements that can be made during operations.

Companies with PC sensors begin to gain a detailed understanding of the events that cause the alerts. This learning allows the operator to gain efficiency overtime by reacting less to alarms that can be predicted (like a planned routine emissions event) or reacting more quickly to a low level alarm over time.

Companies establish "emissions awareness" through using CM – something that is not possible through periodic inspection techniques. Emissions awareness allows operators to:

- Gain awareness of causes and fixes of intermittent leaks, such as a seal in a pressure relief valve cracking yet still holding pressure at appropriate levels;
- Gain awareness around larger emissions events, as many of these are planned or permitted events; and
- Address issues related to contractor performance issues, including failure to follow procedures.

Project Canary's CM system gathers meteorological data readouts and can help pinpoint where the leak is coming from based on the alarm. The system is always evaluating the incoming data and information and improving to reduce the burden on operators to find the exact location of leaks.

Project Canary also works with companies to determine who should receive certain alarms based on the alarm. Based on the type of alarm, the operator can determine what the necessary action is, including, but not limited to: immediate shut-in of the facility; sending out a crew to investigate; or whether to just continue monitoring.

PROJECT CANARY

V. THE CLEAN AIR ACT AUTHORIZES EPA TO ALLOW CM AS AN ALTERNATIVE COMPLIANCE METHOD IN THIS RULEMAKING

A. Allowed for use under NSPS

EPA has broad discretion to include in its new-source regulations under Section 111(b) multiple alternative work practice standards as permissible means of complying with the regulations. Indeed, EPA's November 15 proposal notes that EPA has this discretion and is proposing to exercise it in this rulemaking. *See* 86 Fed. Reg. at 63,197/2 ("[T]he EPA is proposing an alternative work practice for detecting fugitive emissions that incorporates these advanced measurement technologies.").

For the reasons stated elsewhere in these comments, CM meets the statutory requirements for a work practice standard. Specifically, Clean Air Act Section 111(h)(1) authorizes the administrator to promulgate work practice standards that reflect "technological system[s] of continuous emission reduction . . . . taking into consideration the cost of achieving such emission reduction, and any non-air quality health and environmental impacts and energy requirements." CM has been demonstrated as an effective method of assisting companies in reducing their emissions for the reasons set forth in these comments. It has no non-air quality health and environmental impacts. And its energy requirements are minimal because CM systems operate on solar panels and/or small, internally located batteries. We urge EPA in its forthcoming supplemental proposal to solicit public comment on whether CM is appropriate for inclusion as an alternative compliance mechanism in the final rule. And when it finalizes this proposed rule, EPA should expressly allow sources to use CM as an alternative work practice standard to comply with the requirements contained in that final rule.

B. Allowed for existing sources

In addition to the reasons given above with respect to new sources, EPA has even more discretion to allow states in their plans establishing standards of performance for existing sources to choose between multiple alternative work practice standards and allow sources to comply with standards in multiple ways, so long as all the alternatives meet the requirements of the Clean Air Act. "[F]or existing sources the Act adopts a cooperative-federalism approach that leaves the States discretion in determining how their State and industry can best meet quantitative emissions guidelines established by the EPA." *Am. Lung Ass'n v. EPA*, 985 F.3d 914, 942 (D.C. Cir. 2021), *cert. granted*, 142 S. Ct. 418 (Oct. 29, 2021) (citing *Am. Electric Power v. Connecticut*, 564 U.S. 410, 424 (2011).

VI. CM FOR OIL AND NATURAL GAS IS COST-EFFECTIVE

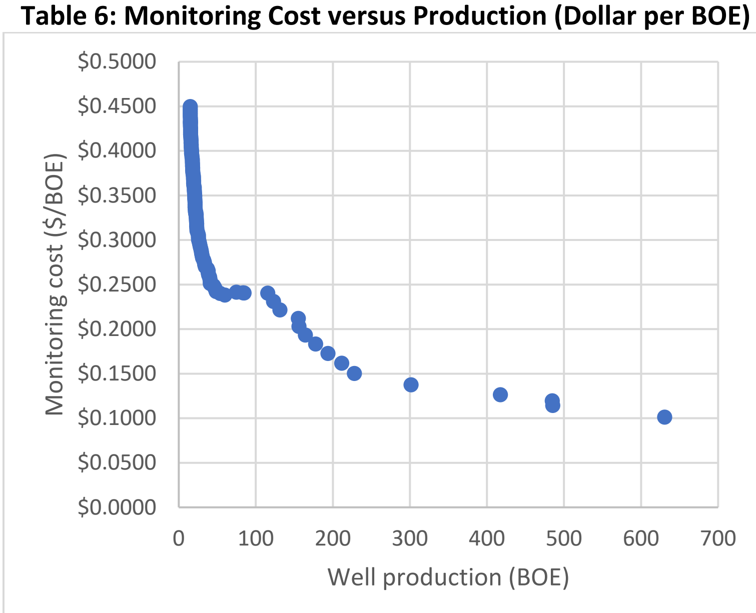
While we do not believe that EPA needs to determine whether CM is cost-effective in order to allow its use as an alternative compliance option, we are providing that information for additional context.[26]

[26] Because we are not recommending that EPA consider CM for selection as a regulatory requirement – whether as a standard of performance derived from the best system of emissions reduction (BSER) under Clean Air Action Section 111(a)(1) or as a

However, using Tables 1 through 3 provided above and comparing that to the cost-effective values used for OGI in Colorado Reg 7, the cost of a CM system per well-site would have to greater than over $340,000 (low bound) to $3.8 million (upper bound) a year for it to not be as cost-effective. As CM systems last multiple years, these values are significantly greater than what the cost of a CM system would be.

Additionally, when these costs are viewed in terms of commodity pricing, they appear even more affordable. Table 6 below was completed by Project Canary for a customer who was considering implementing CM at scale. While the costs can be high for low-producing wells, for most of the wells, the cost of adding three monitors and one anemometer per well site adds well under $0.50 per barrel of oil equivalent (BOE), and as low as $0.10/BOE at some well pads. ***This adds less than one percent to commodity pricing overall and is generally considered cost-effective.***

Table 6: Monitoring Cost versus Production (Dollar per BOE)



VII. The Use of CM Has Been Widely Supported

A. Adoption has been growing rapidly without regulatory drivers

Although CM is a relatively new technology, it has already seen widespread deployment across multiple sectors. It is increasingly used in the exploration, production, and midstream segments of the oil and natural gas industry. The advent of technology solutions such as CM has enabled cost-effective technology deployment and data acquisition. In turn, this has allowed operators to improve their

mandatory work practice standard under Section 111(h)(1) – we do not believe that it is necessary or appropriate to consider the cost-effectiveness of CM relative to optical gas imaging (OGI) or other regulatory requirements.

operations. CM enables operators to deploy emissions management programs, under which operations are continuously monitored, leaks are more frequently detected, and emissions are more reliably measured.

2021 saw a dramatic increase in CM technology deployment. According to Darcy Partners, 71 percent of the exploration and production companies that they work with had already implemented or were planning to implement responsibly sourced natural gas (RSG) within two years.[27] Key drivers include encouragement by investors, competitive ESG pressures to understand and improve operations, and the ability to employ CM to produce differentiated products that can be sold into differentiated, certified, or responsibly sourced gas markets.

B. Statements by non-governmental organizations in support

Various non-governmental organizations (NGOs) have made statements around CM systems for the oil and natural gas industry.

For example, Jeremy Nichols, climate, and energy program director for the environmental group WildEarth Guardians, said CM of emissions instead of just periodic inspections can provide a sense of what's happening at well sites. The sites typically include multiple wells, tanks, and other equipment.[28]

Dan Grossman, senior director of regulatory and legislative affairs at the Environmental Defense Fund, stated that initiatives that include CM systems are positive and might be a good model.[29]

C. Statements by local governments in support

Local governments value the importance of CM systems and have adopted and implemented requirements in efforts to inform their communities.

For example, Broomfield, Colorado has implemented CM and installed six monitoring stations.[30] Also, Aurora, Colorado reached an operator agreement with ConocoPhillips for the use of CM for the life of their well.[31]

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[27] Jack Blears, Darcy Partners, Responsibly Sourced Gas (RSG) Movement Gaining Traction (2022), *available at* https://darcypartners.com/research/certified-low-emissions-gas-gaining-traction.
[28] Judith Kohler, Colorado oil and gas company aims to produce "cleanest molecules" anywhere, *Denver Post* (May 13, 2021), *available at* https://www.denverpost.com/2021/05/13/xcel-energy-crestone-peak-cleaner-gas/.
[29] Statement from Jon Goldstein, Director of Regulatory & Legislative Affairs, Energy, Environmental Defense Fund (Sept. 23, 2020), *available at* https://www.edf.org/media/new-air-quality-rules-tackle-pollution-during-early-stages-oil-and-gas-operations.
[30] Brooklyn Dance, Broomfield City Council approves 2021 oil and gas air quality monitoring agreements, *Broomfield Enterprise* (Dec. 9, 2020), *available at* https://www.broomfieldenterprise.com/2020/12/09/broomfield-city-council-approves-2021-oil-and-gas-air-quality-monitoring-agreements/.
[31] Draft Oil and Gas Operator Agreement Between ConocoPhillips Co. and City of Aurora, Colorado (May 29, 2019), Exh. C, at 12, ¶ 15.3, *available at* https://p1cdn4static.civiclive.com/UserFiles/Servers/Server_1881137/File/Residents/Oil%20and%20Gas%20Drilling/ConocoPhillips%20Draft%20Operator%20Agreement%20May%2029%202019.pdf.

VIII. CM CAN HARMONIZE WITH EPA AND SEC CLIMATE CHANGE REQUIREMENTS

The U.S. Securities and Exchange Commission (SEC) is planning to propose several regulations and other administrative actions relating to environmental, social, and governance (ESG) factors and climate risk disclosure, in a parallel track to EPA's development of this rule. These actions will significantly impact the oil and natural gas sector – and those interested in investing in that sector.

The regulations the SEC is considering over the next six months, include but are not limited to: mandatory climate change disclosures; shareholder proposals in proxy statements; rules relating to investment companies and investment advisors to address matters relating to ESG; and climate stress testing for large asset managers and large investment companies.

One of the main issues relates to the United States greenhouse gas reporting program (GHGRP) that is run by EPA. The onshore oil and natural gas sector is required to submit information under Subpart W of 40 CFR Part 98 for the GHRP. Both environmental groups and the oil and natural gas industry do not believe that Subpart W accurately captures the emissions from the oil and natural gas sector – whether it be underreported or overreported. Part of the reason for issues with capturing accurate data comes from Subpart W using over 100 emissions factors (EF) for determining how much is emitted from the oil and natural gas sector. CM can help eliminate the need for the use of EF as it can provide real information on emissions. This will also help bridge the gap on what a company may report to the SEC under its forthcoming regulations and what is being provided under the EPA GHGRP.

It is key that the SEC and EPA communicate to avoid unnecessary reporting burden or duplicative or conflicting requirements. Luckily, CM can help bridge the gap between the two regulations by providing a compliance alternative for EPA, while also serving as a mechanism to allow for compliance with SEC's upcoming regulations. CM provides a way to ensure that companies are providing the reductions that they are claiming on their SEC filings with respect to climate change.

IX. CM ENABLES DOMESTIC AND INTERNATIONAL GAS MARKETS

CM has enabled the development of domestic and international certified RSG markets. CM does this by enabling the development of domestic and international certified RSG markets. In 2021 alone, nearly 75 operators in the US have committed to devoting resources to RSG markets. It is estimated that between 20 and 25 percent of the US natural gas market will be dedicated to RSG markets, meeting the needs of utilities and liquefied natural gas (LNG) buyers.[32] CM allow operators to demonstrate low emissions production and RSG markets are seeking low methane emissions intensity certificates.[33] Through partnerships with operators, Project Canary has seen production-related methane emission reductions of an estimated 80 percent. This type of emissions measurement and performance will enable the industry to meet low or net-zero commitments across the energy sector.

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[32] Project Canary, What is RSG? A Definitive Guide to Differentiating Gas and the Certification Process (Nov. 19, 2021), *available at* https://www.linkedin.com/pulse/what-rsg-definitive-guide-differentiating-gas-certification-/.
[33] *Id*.

Kevin Book, a managing director at ClearView Energy Partners LLC, has observed that that RSG is key for parts of the world where efforts are underway to maximize clean, affordable energy output.[34] EQT, the largest U.S. natural gas producer, is working to certify their natural gas from their Appalachian natural gas production.[35]

Project Canary's standards for RSG include and build upon the standards set forth by ONE Future, the American Gas Association, NORSOK, ISO, and the American Petroleum Institute.[36]

CM systems allow for American oil and natural gas companies to show how clean our production is – especially relative to other locations around the world.

[34] Jamison Cocklin, RSG Seen as Key to Unlocking More Natural Gas Export Demand in Developed Countries, *Natural Gas Intelligence* (Nov. 24, 2021), *available at* https://www.naturalgasintel.com/rsg-seen-as-key-to-unlocking-more-natural-gas-export-demand-in-developed-countries/.
[35] *Id*.
[36] *Id*.

PROJECT CANARY

APPENDIX A – FEAST ANALYSIS

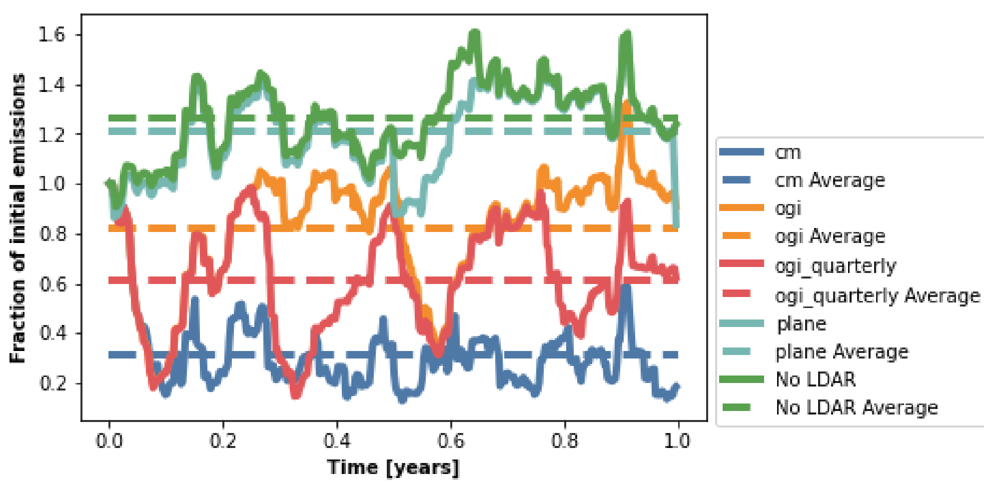
The FEAST model compares and evaluates different approaches to leak detection and repair based off realistic oil and natural gas emissions. The model simulates emissions and compares different technology's ability to detect those emissions given wind conditions, emission size, and sampling frequency. The model allows for the simulation of different emission detection technologies as part of an overall LDAR program.

In this analysis, we compared continuous monitors with detection capabilities similar to Project Canary's continuous monitors to standard bi-annual OGI, quarterly OGI, bi-annual plane-based detection, and CM. These scenarios were compared to a base no LDAR scenario, in which operators do not respond to leaks.

The analysis was conducted using FEAST v3.1[37] and assumed leak detection times of 0 to 5 days, depending on windspeed and emission rate (see below table). We view this assumption to be largely conservative, given testing at METEC where all leaks have been observed within at least an hour of a release, and our field experience. All other parameters, such as repair time, are kept as model defaults.

Results show that CM can help operators eliminate nearly 80% of emissions. Additionally, these results show that continuous monitors reduce emissions more than both bi-annual and quarterly OGI camera inspections, and are much more effective at emissions reduction than aerial surveys.

Figure 6: FEAST Analysis



[37] *Available at* https://github.com/FEAST-SEDLab/FEAST_PtE; C. Kemp et al., Comparing Natural Gas Leakage Detection Technologies Using an Open-Source "Virtual Gas Field" Simulator, *Environ. Sci. Tech*. 50 4546 (2016), *available at* http://dx.doi.org/10.1021/acs.est.5b06068.

Table 7: Time to detection for FEAST model

Emissions flux rate (g/s)	Mean windspeed (m/s)	Time to detection (days)
0.5	1.0	0
1.0	1.0	0
1.1	1.0	0
0.5	5.0	1
1.0	5.0	1
1.1	5.0	1
0.5	5.1	5
1.0	5.1	5
1.1	5.1	5

Data for low windspeed case are derived from METEC testing data, and data for high windspeed cases are estimated using NOAA's Ready model.

APPENDIX B – STANDARD OPERATING PROCEDURES

DATE OF ISSUE:	SUPERSEDES: V.1	Control Number:
EFFECTIVE DATE:	EXECUTIVE OWNER:	

ENDORSEMENTS:

NAME	TITLE	SIGNATURE	DATE

1.0 PURPOSE

This procedure has been developed to establish a consistent process for evaluating Canary S™, Canary X, and Canary SX (Canary) continuous emissions monitoring data (CEM) and defining the company's response thresholds.

2.0 SCOPE AND APPLICATION

This Procedure lays out how the company will implement and evaluate the Canary CEM program and data in tandem with the company's LDAR program defined by CDPHE Regulation No. 7.

3.0 ACRONYMS AND DEFINITIONS:

APCD	Air Pollution Control Division
AVO	Audio, visual, and olfactometry
CDPHE	Colorado Department of Public Health and Environment
CEM	Continuous emissions monitoring
PM	Particulate matter
NOx	Nitrogen oxides
VOC	Volatile Organic Compound
FLIR	Forward Looking Infrared
LDAR	Leak detection and repair
ppm	Parts per million

4.0 RESPONSIBILITIES AND AUTHORITY

Executive Owner –

The Vice President of Environmental, Health, Safety & Regulatory (EHS&R), or designee(s) is accountable for ensuring that all of the companies employees and contractors working under the direction of Company name are trained to this Procedure prior to participation in the CEM program.

5.0 PROCEDURE REQUIREMENTS

Individuals executing this Procedure must have completed general awareness training on the Company name EHS&R management system.

6.0 HEALTH AND SAFETY

6.1 Field Safety Requirements

a. Personal protective equipment requirements:
    i. Hard hat
    ii. Steel toe shoes
    iii. Safety glasses
    iv. Fire-resistant clothing (outermost layer)
    v. Hearing protection (when conditions warrant)
    vi. Four-gas monitors
b. Driving: Operating a motor vehicle will be conducted according to the company's "Safe Vehicle Usage Practice" document.
c. Respiratory Hazards: Condensate storage tank thief hatch repair and maintenance subjects the LDAR Technician to the greatest risk of an inhalation hazard. Any thief hatch work should be conducted as safely as possible and in accordance with the "Thief Hatch Repair and Maintenance" Standard Operating Procedure.

7.0 QUALITY ASSURANCE AND CONTROLS

This controlled document is subject to an annual review by the Executive Owner (see Section 7.1 of Procedure **53.10Aa** for details).

This controlled document is subject to a formal triannual update by the subject matter expert assigned to this document (see Section 7.2 of Procedure **53.10Aa** (Controlled Documents Procedure) for details.

8.0 PROCEDURE REQUIREMENTS

8.1 Field Monitoring Setup

a. Equipment:
    i. Canary monitoring equipment will include:
        1. Anemometer
        2. Total hydrocarbon sensor
        3. NOx sensor (if installed)
        4. PM sensors (if installed)
        5. Modem and cloud connection

      6. Solar power equipment
      7. Summa (if installed)
   ii. FLIR Camera
   iii. Apple iPad
b. Technology:
   i. Canary provided website: https://dashboard.projectcanary.io
      1. Data will be continually received from the field.
   ii. Intelex ACTs database
      1. Stores LDAR inspection information
   iii. Prontoforms iOS App
      1. Logs LDAR inspections
c. Canary Alarm Thresholds
   i. 5-minute VOC average threshold set at 3 ppm
   ii. Instantaneous VOC spike threshold set at 10 ppm.
   iii. The 24-hour average threshold set at 1 ppm
   iv. Instantaneous VOC spike threshold set at 7 ppm (Summa, if installed)
   v. 90-minute VOC average threshold set at 10 ppm
d. The company's Canary Team (Team)
   i. LDAR technician(s)
   ii. Air Quality Supervisor
   iii. Vice President of EHS&R

8.2 Canary Field Monitoring Procedure

a. The Canary website and database will notify the Team based on the 5-minute average, 90-minute average, and 24-hour averages or the instantaneous spike threshold.
b. The alarm event is less than 45 minutes from the initial alarm timestamp:
   i. The Canary graph will be evaluated to determine if the ppm levels have returned to the pre-alarm threshold.
      1. If readings have returned to near-normal levels (within 0.5 ppm of monthly pre-alarm average) for 20 minutes following the 45-minute window, the alarm is considered resolved.
      2. If the readings are below the alarm threshold but not returned to near-normal levels for 20 minutes following the 45-minute window the site will be monitored for 24 hours.
         a. If levels do not increase, then the alarm will be considered resolved.
         b. If levels increase to above any alarm threshold, an LDAR technician will be dispatched on the next business day to perform a FLIR camera site inspection.
c. Alarm events that persist more than 45 minutes on a business day.
   i. The lease operator and/or Cygnet will be utilized to determine if normal facility operations are occurring.
      1. If normal operations or maintenance are being performed, then the alarms will be monitored to ensure the site readings return to normal.

            a. If normal operations are occurring, the alarm timestamp, type of operation (i.e., water hauling, drip pot cleaning, etc.), and start time of operational activity will be recorded in Log of Operational Events and Canary Alarms (Maintained on the company's network).
        2. If normal operations or maintenance are not being performed or the lease operator does not respond to the call within 15 minutes, an LDAR technician will be dispatched to the site as soon as possible but no later than the next business day to perform a FLIR camera site inspection.
            a. If the LDAR technician is en route and the cause is determined by correlating alarm timestamp to the start of normal operations, an inspection will not be performed.
            b. If normal operations are occurring, the alarm timestamp, type of operation (i.e., water hauling, drip pot cleaning, etc.), and start time of operational activity will be recorded in Log of Operational Events and Canary Alarms (Maintained on the company's network).

d. Any alarm events that occur outside of the company's business hours (evenings, weekends, holidays) will be evaluated on the next business day.
    i. For durations of less than 3 hours, the process is defined in 8.2.b.i will be following.
        1. The Canary graph will be evaluated to determine if the ppm levels have returned to the pre-alarm threshold.
    ii. For alarm events greater than 3 hours but not still alarming the lease operator and Cygnet will be consulted.
        1. If the cause of the alarm can be identified, then the cause will be noted, and ppm readings will be evaluated to confirm levels have returned to normal.
            a. If normal operations are occurring, the alarm timestamp, type of operation (i.e., water hauling, drip pot cleaning, etc.), and start time of operational activity will be recorded in Log of Operational Events and Canary Alarms (Maintained on the company's network).
        2. If the cause is unknown or levels have not returned to normal, an LDAR technician will perform a FLIR camera site inspection on the next business day.
    iii. For alarm events that have not concluded, a lease operator will be dispatched to conduct an AVO inspection to try and identify the issue. If the issue is not identified, an LDAR technician will be dispatched within 12 hours.

e. If an alert leads to the deployment of an LDAR team, the alarm timestamp will be recorded in Log of Canary Alarms and LDAR inspection (Maintained on the company's network).

f. An instantaneous sample is triggered by the continuous monitoring station when an air-quality event is detected. In this case, the evacuated summa canister is opened following an aggregated minute level reading above the 7-ppm threshold. The canister is kept open for a full 60-minute sampling period. At the end of 60 minutes, the canister's valve closes automatically. Instantaneous alerts are sent to Project Canary and the company with the sampling period and Project Canary field staff are deployed to gather the canister for analysis and install a replacement canister.

g. Alarm events that persist more than 90-minutes and have an average VOC of 10 ppm will initiate a notification to the company's control room to dispatch personnel to the site immediately. Upon confirmation, this type of event has occurred the company will notify the Division and the local government with jurisdiction over the location of the operations within 48 hours.
    i. The lease operator and/or Cygnet will be utilized to determine if normal facility operations are occurring.
        1. If normal operations or maintenance are being performed, then the alarms will be monitored to ensure the site readings return to normal.
            a. If normal operations are occurring, the alarm timestamp, type of operation (i.e., water hauling, drip pot cleaning, etc.), and start time of operational activity will be recorded in Log of Operational Events and Canary Alarms (Maintained on the company's network).
            b. Repairs and corrective actions will be tracked and recorded in the Log of Operational Events and Canary Alarms
        2. If the cause is unknown or levels have not returned to normal, <u>the site will be shut down.</u>

8.3 Record-Keeping Requirements

a. Reg. 7 and NSPS 40 CFR Subpart OOOOa LDAR inspections maintained in ACTs.
b. Log of Canary Alarms and LDAR inspection (Maintained on the company's network) maintained on the company's network.
c. Log of Operational Events and Canary Alarms (Maintained on the company's network) Maintained on the company's network.

9.0 MANAGEMENT OF CHANGE

This document is subject to the company's Management of Change Procedure.

10.0 VIOLATIONS

Violations of this Procedure and related policies and procedures by employees may result in disciplinary action up to and including termination. Violations of this Procedure by contractors and other authorized third parties may result in the revocation of such party's access to the company's premises and/or electronic access to its systems, and the termination of such party's contract for services.

11.0 REFERENCES

- Management of Change Practice (52.10Aa).
- EHS&R Master List of Controlled Documents.

12.0 REVISION HISTORY AND EXPIRATION

Note: Revision # should be listed in descending order starting with the most recent version at the top

REV. #	DATE	Description/Modification	Revision Section (s)	Author(s)

13.0 ATTACHMENTS

- Log of locations with Canary continuous emission monitoring equipment, including:
  - Equipment installation date; and
  - Sensor technology installed.

APPENDIX C – ANALYSIS OF METHANE EMISSIONS REDUCTIONS FROM ALTERNATIVE COMPLIANCE MECHANISMS

Table 8: Reduction in methane emissions from continuous monitoring (CM) relative to quarterly Optical Gas Imaging (OGI)

Year	Number of Well Sites	Methane Reductions per Site			Social Cost of Methane	Total Methane Reductions (millions of short tons)			Total Carbon Dioxide Equivalent Reductions (millions of short tons)			Monetized Benefits (millions of 2019 dollars)		
		Large Emissions Event	Small Emissions Event	Intermittent Emissions Event		Large Emissions Event	Small Emissions Event	Intermittent Emissions Event	Large Emissions Event	Small Emissions Event	Intermittent Emissions Event	Large Emissions Event	Small Emissions Event	Intermittent Emissions Event
2023	13,000	1,451.9	143.6	717.9	$1,600	19	2	9	472	47	233	$26,832	$2,654	$13,267
2024	19,000	1,451.9	143.6	717.9	$1,700	28	3	14	690	68	341	$40,453	$4,001	$20,002
2025	24,000	1,451.9	143.6	717.9	$1,700	35	3	17	871	86	431	$49,610	$4,907	$24,530
2026	280,000	1,451.9	143.6	717.9	$1,800	407	40	201	10,163	1,005	5,025	$594,986	$58,847	$294,194
2027	270,000	1,451.9	143.6	717.9	$1,800	392	39	194	9,800	969	4,846	$557,026	$55,093	$275,424
2028	260,000	1,451.9	143.6	717.9	$1,900	377	37	187	9,437	933	4,666	$549,704	$54,368	$271,804
2029	260,000	1,451.9	143.6	717.9	$1,900	377	37	187	9,437	933	4,666	$533,693	$52,785	$263,887
2030	250,000	1,451.9	143.6	717.9	$2,000	363	36	179	9,074	898	4,487	$524,442	$51,870	$259,313
2031	240,000	1,451.9	143.6	717.9	$2,000	348	34	172	8,711	862	4,307	$488,800	$48,345	$241,690
2032	240,000	1,451.9	143.6	717.9	$2,100	348	34	172	8,711	862	4,307	$498,291	$49,283	$246,383
2033	230,000	1,451.9	143.6	717.9	$2,100	334	33	165	8,348	826	4,128	$463,621	$45,854	$229,240
2034	230,000	1,451.9	143.6	717.9	$2,200	334	33	165	8,348	826	4,128	$471,551	$46,639	$233,161
2035	230,000	1,451.9	143.6	717.9	$2,200	334	33	165	8,348	826	4,128	$457,817	$45,280	$226,370
Totals:	2,546,000	18,875	1,867	9,333		**3,697**	**366**	**1,828**	**92,413**	**9,140**	**45,694**	**$5,256,825**	**$519,926**	**$2,599,266**

Table 9: Reduction in methane emissions from bimonthly flyover to quarterly Optical Gas Imaging (OGI)

Year	Number of Well Sites	Methane Reductions per Site			Social Cost of Methane	Total Methane Reductions (millions of short tons)			Total Carbon Dioxide Equivalent Reductions (millions of short tons)			Monetized Benefits (millions of 2019 dollars)		
		Large Emissions Event	Small Emissions Event	Intermittent Emissions Event		Large Emissions Event	Small Emissions Event	Intermittent Emissions Event	Large Emissions Event	Small Emissions Event	Intermittent Emissions Event	Large Emissions Event	Small Emissions Event	Intermittent Emissions Event
2023	13,000	(1,451.9)	0.0	580.8	$1,600	(19)	0	8	(472)	0	189	($26,832)	$0	$10,733
2024	19,000	(1,451.9)	0.0	580.8	$1,700	(28)	0	11	(690)	0	276	($40,453)	$0	$16,182
2025	24,000	(1,451.9)	0.0	580.8	$1,700	(35)	0	14	(871)	0	348	($49,610)	$0	$19,846
2026	280,000	(1,451.9)	0.0	580.8	$1,800	(407)	0	163	(10,163)	0	4,066	($594,986)	$0	$238,011
2027	270,000	(1,451.9)	0.0	580.8	$1,800	(392)	0	157	(9,800)	0	3,920	($557,026)	$0	$222,826
2028	260,000	(1,451.9)	0.0	580.8	$1,900	(377)	0	151	(9,437)	0	3,775	($549,704)	$0	$219,897
2029	260,000	(1,451.9)	0.0	580.8	$1,900	(377)	0	151	(9,437)	0	3,775	($533,693)	$0	$213,492
2030	250,000	(1,451.9)	0.0	580.8	$2,000	(363)	0	145	(9,074)	0	3,630	($524,442)	$0	$209,791
2031	240,000	(1,451.9)	0.0	580.8	$2,000	(348)	0	139	(8,711)	0	3,485	($488,800)	$0	$195,533
2032	240,000	(1,451.9)	0.0	580.8	$2,100	(348)	0	139	(8,711)	0	3,485	($498,291)	$0	$199,330
2033	230,000	(1,451.9)	0.0	580.8	$2,100	(334)	0	134	(8,348)	0	3,340	($463,621)	$0	$185,461
2034	230,000	(1,451.9)	0.0	580.8	$2,200	(334)	0	134	(8,348)	0	3,340	($471,551)	$0	$188,633
2035	230,000	(1,451.9)	0.0	580.8	$2,200	(334)	0	134	(8,348)	0	3,340	($457,817)	$0	$183,139
Totals:	2,546,000	(18,875)	0.0	7,550		**(3,697)**	**0**	**1,479**	**(92,413)**	**0**	**36,968**	**($5,256,825)**	**$0**	**$2,102,875**

The methane reduction per site is based on the information developed as part of EPA's regulatory impact analysis as part of the rulemaking. The Social Cost of Methane values are based on the Office of Management and Budget's (OMB) February 2021 document titled *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990*, Table A-2. The monetized benefits are provided in a net present value (NPV) using a 3 percent discount rate.