Comment Letter re: Supplemental Notice of Proposed Rulemaking – Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review

Introduction

Bridger Photonics, Inc. ("Bridger") appreciates the opportunity to provide comments on the Environmental Protection Agency's ("EPA") Supplementary Notice of Proposed Rulemaking – Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review (87 FR 74702) ("Proposed Rule"). Bridger is a technical and market leader in the detection, localization, and quantification of methane emissions. Bridger commercialized its aerial light detection and ranging (LiDAR) technology, Gas Mapping LiDAR™, in 2019 as a data product offering, which has been rapidly and broadly adopted by the oil and gas industry in North America over the past four years.

Bridger's experience developing advanced methane sensing technology and adapting our data product to the needs of the oil and gas industry has helped us develop a strong understanding of the practical application of next generation emissions monitoring. Meanwhile, our operations throughout North America have provided us with a clear picture of what methane sensing performance specifications are required to effectively reduce emissions. Our combined operational and scientific knowledge uniquely situates us to provide appropriate feedback on how aspects of the Proposed Rule can be adjusted to advance the stated goals of the EPA. These goals include to "significantly reduce emissions of greenhouse gases and other harmful air pollutants from the Crude Oil and Natural Gas source category" and to "minimize any significant economic impact of the proposed rule [on the O&G industry]."[1]

The EPA made momentous progress in the regulatory adoption of advanced methane sensing technologies ("advanced technology") by striving for a technology agnostic framework for emissions monitoring and a centralized technology approval process in the Proposed Rule. Regulatory acceptance and industry adoption of these advanced technologies will open the door for more efficient emissions reduction, which is recognized as essential for overcoming the challenge of implementing comprehensive emission mitigation measures.[2,3]

Bridger strongly supports provisions in the Proposed Rule that streamline compliance by enabling both fugitive emissions monitoring and compliance verification of zero emissions numerical standards to be accomplished during a single site scan with methane sensing technology. We also commend the EPA for making the detection sensitivity requirements for periodic screening stringent by basing them on a mass emission rate 90% probability of detection (PoD).

In this letter, Bridger provides recommendations that will help the EPA fortify its regulatory framework, improve the performance-based technology agnostic nature of the regulation, and reward technologies for improved performance. Our comments are centered on five areas:

1. Requirements for emissions detected by advanced technologies;
2. Emissions monitoring approach equivalency determination;
3. The periodic screening matrix;
4. Recommendations for the alternative test method approval process; and,
5. Additional points that need clarification.

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Comment Area 1: Requirements for Emissions Detected by Advanced Technologies

Comment 1.1. The response to emissions detected using an alternative test method must be situationally appropriate.

The “blanket” follow-up OGI survey for emissions detected by advanced technology in the periodic screening matrix is an ineffective approach to mitigating emissions. Advanced technologies may detect, record, and characterize many emission sources for which OGI follow-up is unnecessary, unhelpful, and/or impractical. A mandatory OGI sweep will create a disincentive for operators to deploy advanced technologies for compliance with the Proposed Rule by causing an undue burden when it is not an appropriate or useful response. Moreover, sending an OGI crew for each detected emission (instead of more effective responses) will also decrease safety. NIOSH / CDC found that in 2017 (and qualitatively similar results in 2015-2016), vehicle accidents for oil and gas extraction related field operations were the leading cause of fatalities (42%). Of these, the majority were on roadways to/from/between sites.[a]

The mandatory OGI follow-up is particularly burdensome for the more sensitive detection tiers because more sites with emissions will be identified by the advanced technology leading to a greater OGI follow-up burden. For the 1 kg/hr (90% POD) tier, Bridger will detect emissions on more than 50% of sites in the Permian Basin and OGI crews would be required to be deployed to each of these sites. Therefore, as written, the Proposed Rule disincentivizes better detection sensitivities.

Compared to a universal OGI follow-up requirement, a better approach to responding to emissions will often involve investigative analysis using a combination of advanced technology data (Figure 1), compressor runtime data, process control / SCADA data, maintenance activity logs, AVO inspection, and prior screening results. The spatiotemporal data from advanced technologies (including replicate infrastructure scans) can be especially useful in this process if the advanced technology can precisely localize the emission, identify the emission as normal or abnormal, identify the emission as intermittent, and/or directly identify its cause.

Intermittent emissions are one scenario where OGI follow-up may be an ill-suited response. For example, process upsets may cause over pressurization of cover/closed vent systems resulting in emissions that are detected during an infrastructure scan but are no longer present according to a successive scan to evaluate persistence. Because of intermittent behavior, follow-up OGI has a reduced likelihood of confirming the emission and would not provide additional helpful information in either case. Meanwhile, suitable advanced technologies will already have clearly identified the emission point. An investigation into the process upset conditions that caused the emission could help elucidate necessary updates to system parameters that would mitigate future emissions. In this example, an OGI follow-up does not increase emissions reductions and causes undue burden on the operator. For intermittent emissions, investigative analysis is the appropriate requirement instead of a blanket OGI follow-up requirement.

[a] https://www.cdc.gov/niosh/topics/fog/data2017.html

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For normal process emissions that are detected by alternative emissions monitoring, OGI follow-ups may be ineffective. In the case of permitted emissions from natural gas fired internal combustion engines and control devices, OGI may have difficulty differentiating between normal and abnormal operation, which, for control devices, was recognized in the Proposed Rule.[b] However, these emission sources are regularly detected by advanced technologies even when normally operating. To provide fair and consistent rules, the EPA should not require onsite follow up in response to emissions detected during periodic screening that correspond to normal process emissions operating within permitted emission bounds. Separate performance standards in the Proposed Rule already apply to these types of emission sources. If permitted process emission are detected and conclusively identified, then no response other than recordkeeping and reporting should be necessary.

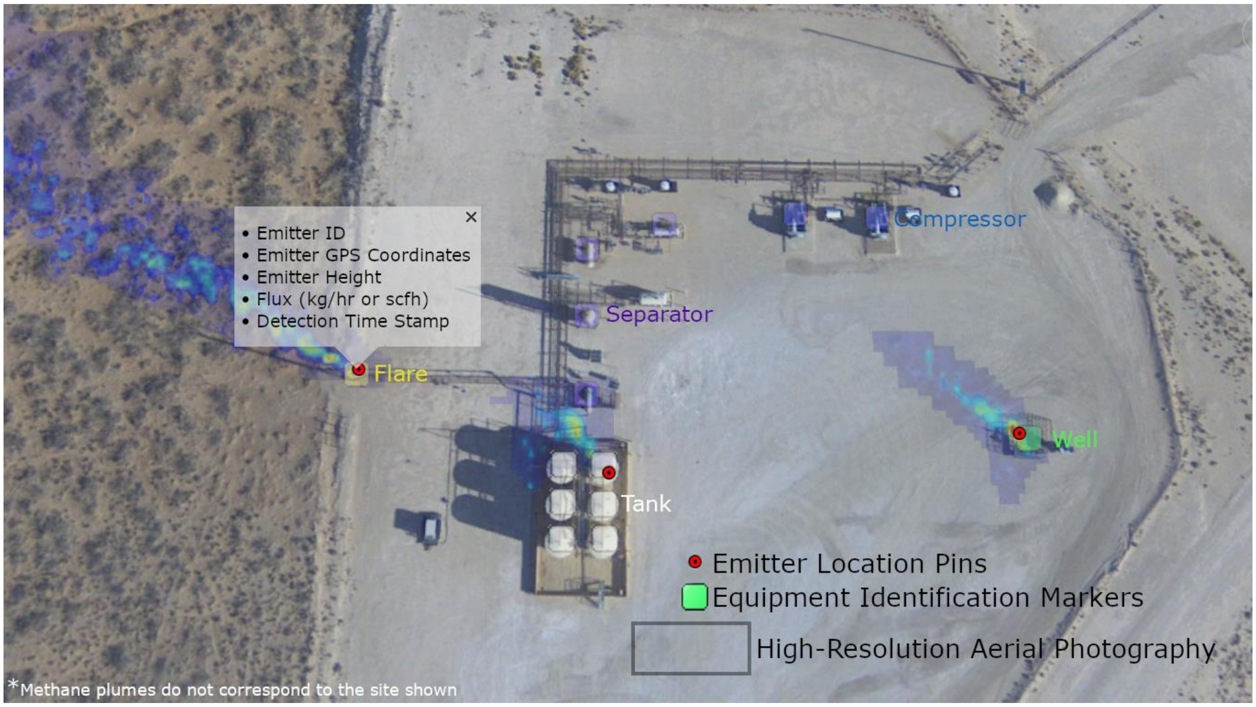

Figure 1. Examples of several emission types routinely detected by Bridger's Gas Mapping LiDAR™ (GML) technology and demonstration of certain GML data attributes. Emission sources can often be clearly identified, and a variety of metadata is provided for causal analysis. Due to confidentiality requirements, the dataset shown is synthetic but it is representative of field measurements.

We recommend that EPA design the Final Rule to allow operators to choose the most effective follow up response based on the advanced technology's capability to identify the emission cause. EPA should consider providing more choices on how to respond when emissions are detected, similar to the approach used in the fenceline monitoring work practice promulgated by EPA in 2015 as part of the NESHAP for the petroleum refinery sector.[4] Under that rule, if an operator determines an action level exceedance, the operator must initiate an investigative analysis which may include: leak detection using Method 21 (M21), leak detection using OGI, or employing progressively more frequent sampling using Method 325A and 325B.[5] In the preamble of that rule, EPA stated that "the premise of the fenceline monitoring is to provide the refinery owners or operators with the flexibility to identify the most efficient approaches to

[b] "One commenter stated that emissions resulting from noncompliance with control device requirements should not…be defined as fugitive emissions…since control devices are inherently designed to have emissions, even when well operated, it should be expected that some amount of methane and VOC would be detected during an OGI survey for fugitive emissions. The EPA agrees that control devices should not be treated as fugitive emissions components…".[20]

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reduce the emissions that are impacting the fenceline level."[6] We recommend providing similar options for operators to use advanced technologies to efficiently fix leaks in the Final Rule.

In addition to source identification, the OGI follow-up requirement was also developed to identify the presence of emissions that were not identified by advanced technology screening. However, this approach conflicts with the EPA's mission to develop a framework for emissions monitoring that is performance based and technology agnostic. For the framework to fit these criteria, the desired emission reductions must be achieved by the alternative test method itself and not hinge on supplemental screening with OGI cameras to detect additional emissions at sites where emissions are detected by an alternative approach. Moreover, for sensitive technologies, the impact of searching for additional emissions will be minimal even though the Proposed Rule burdens increased sensitivity with a greater number of sites requiring OGI follow-up (as previously discussed).

Although a full-site OGI scan should not be required every time an emission is detected at a site, if annual OGI is required at the periodic screening sensitivity tier being used, then operators should have the option to complete a full-site OGI survey during detection follow-up to satisfy the yearly OGI requirement at that site. This could improve operations efficiency and reduce a backlog of sites that need to be visited for yearly OGI. This recommendation is consistent with the November 2021 Proposed Rule.[1]

Summary of Comment 1.1. We urge the EPA to allow operators to respond to emissions detected by advanced technologies using situationally appropriate investigative analysis.

Comment 1.2. OGI follow-up on emissions detected using an alternative test method should be guided by the emission source localization performance of the methane sensing technology used.

When an emission is detected by periodic screening, the Proposed Rule requires a full-site OGI survey to determine the source of the detected emission and any other fugitives present. However, many advanced methane sensing technologies have equipment scale resolution, and it is redundant and burdensome to require an OGI survey of all equipment pieces at a site to locate the emission source, which has already been identified to belong to a single equipment unit. It is a standard practice to use OGI to determine the specific emitting component by screening infrastructure within the localization uncertainty of the methane sensing technology. When OGI is an appropriate element of investigative analysis for an emission detected by advanced technologies, we urge the EPA to allow operators to direct the OGI survey within the localization uncertainty region of the advanced technology. This practice maintains the efficiency gained by technologies that can rapidly screen oil and gas sites for emissions and precisely localize emission sources.

FEAST modeling was used to support the periodic screening framework development. Modeling efforts simulated periodic screening as aerial surveys with site-level resolution. In the simulation protocol, emission detection at a site triggered a full-site OGI survey. Although this approach was based on prior literature,[7] it is not suitable for modeling a technology agnostic framework. Various methane sensing technologies that could be used in this framework have localization capabilities spanning site-level, equipment group-level, equipment unit-level, and component-level precision. For technologies with site-level localization, a large set of infrastructure may need to be investigated to conclusively identify emissions sources. For technologies that can localize emissions to specific components additional emissions screening is redundant. It is foreseeable that advanced handheld instruments, UAV-mounted sensors and/or aerial technologies will provide component-level resolution and be used for periodic screening. We urge the EPA to develop regulations that recognize the localization capabilities of advanced methane sensing technologies and encourage technological improvement in this area.

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Follow-up requirements for emissions detected by alternative test methods should be guided by the known capabilities of advanced methane sensing technologies. Extensive studies have been performed to characterize emission source localization such as those completed at the Methane Emissions Technology Evaluation Center (METEC) which was developed with support from the Department of Energy's Advanced Research Program Agency-Energy (ARPA-E).[8–10] These studies categorize localization precision as site-level, equipment group-level, and equipment unit-level precision. Bridger recommends the EPA to refine alternative emissions monitoring follow up requirements to correspond to these localization precision levels. For a test method to be classified at a given level of localization precision, 95% of its detections should be correctly localized.

Summary of Comment 1.2. We urge the EPA to refine the periodic screening OGI follow-up requirement to correspond to the localization performance of the methane sensing technology that originally detected the emission. Localization performance should be defined based on established precedent, with precision being defined at site-level, equipment group-level, equipment unit-level, and component-level.

Comment 1.3. Emissions detected using the continuous monitoring alternative approach may require OGI follow-up.

Although the Proposed Rule requires follow-up OGI screening for emissions detected during periodic screening,[c] equivalent requirements are not delineated for the alternative continuous monitoring program, which damages the intended technology agnostic nature of the rule. Site-level emission action levels for the continuous monitoring alternative approach could be triggered by an aggregate set of emissions, and OGI screening would help locate individual emission sources and make sure the aggregate methane flux is accounted for. To reduce the OGI follow-up requirement to only what is necessary to reduce emissions, the scope of OGI surveys should correspond to the localization capabilities of the continuous monitoring method (as was recommended for the periodic screening approach in Comment 1.2). Continuous monitoring systems localize emissions with different degrees of precision, which has been characterized by independent researchers.[10] In order for the EPA to continue developing a consistent, practical, and technology agnostic framework to use advanced methane sensing technologies for emissions monitoring, we urge the EPA to include the same OGI follow-up requirements for the continuous monitoring alternative approach as for the periodic screening alternative approach.

Summary of Comment 1.3. To maintain consistency and be technology agnostic, we urge the EPA to include the same OGI follow-up requirements for the continuous monitoring alternative approach as for the periodic screening alternative approach.

Comment 1.4. Incentivize the detection and mitigation of compliance issues identified by advanced technologies.

Due to the more comprehensive spatial and temporal coverage of advanced technologies, considerably more emission sources may be revealed that represent compliance issues as compared to standard OGI surveys. Examples of such sources include malfunctioning control devices as well as cover and closed vent system failures. Under the Proposed Rule, the additional detection of such a compliance issue by an advanced technology could penalize the operator with a violation and potentially large fine. Such additional risk of incurring violations strongly disincentivizes the use of effective and comprehensive

[c] It is unclear if FEAST modeling used to investigate equivalence involved OGI followup. In the 'RS Run Script plane.txt' python script provided in the docket, the continuous monitoring LDAR program object, 'cont_monitor' did include OGI in the 'dispatch_object' field. Regardless, OGI follow up was not specified in the Proposed Rule.

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detection technologies. We therefore urge the EPA to provide an efficient and explicit compliance pathway in the final rule for addressing such compliance issues detected by advanced technologies that enables operators to avoid a violation if the source is appropriately mitigated.

Summary of Comment 1.4. We urge the EPA to provide a compliance pathway for compliance issues detected by advanced technologies to remove disincentives for detecting emissions.

Comment 1.5. More than 30 days are needed to repair emissions following periodic screening.

The 30-day timeline for repairing emissions detected during periodic screening does not allow operators enough time to follow up on detected emissions. Certain advanced methane sensing technologies that will be used for periodic screening can cover 100+ sites in a single day. This level of efficiency is a major reason that operators benefit from access to these technologies. Compared to the ~5 sites per day that can be screened by OGI,[11] efficient aerial screening would generate a much larger workload of follow-up repairs in a short period of time. To overcome this challenge, the EPA should allow a longer repair timeline for emissions detected during periodic screening. It is also necessary to consider time needed for data to be fully processed before it is delivered to operators. Operators typically wait for fully processed datasets, which contain mass emission rates that they use to prioritize repair activities. More time is warranted to allow emissions data to be processed and delivered to operators. We urge the EPA to allow operators 45 days for a first repair attempt on emission sources detected during the periodic screening alternative approach.

Summary of Comment 1.5. We urge the EPA to allow 45 days after site screening to complete repairs on emission sources detected during the periodic screening alternative approach.

Comment Area 2: Emissions Monitoring Approach Equivalency Determination

Comment 2.1. New emission rate distributions are available that enable correction and validation of FEAST modeling inputs.

Since the November 2021 proposal, significant research has been made public that bears critical implications for modeling the performance of different emissions monitoring approaches. To ensure that the final rules are based on an accurate representation of existing emissions distributions as observed by recent measurement campaigns, and modeling is based on the emissions reductions that can be achieved by advanced technologies, the EPA must take this research into consideration. For example, Bridger recently submitted a paper for publication that describes an emission rate distribution measured in the Permian Basin with continuous coverage from large emission rates down to rates below 2 kg hr^{-1} (2 kg hr^{-1} emission rates were detected with 90% PoD).[12] It is possible to compare the distribution of emissions simulated in FEAST[13] with this extensive empirical emission rate distribution because it overlaps with the large-emitter, tank, and component emissions rate distributions that were bootstrapped during the EPA's FEAST modeling. Preliminary investigations suggest that emissions with rates between 600 and 1 kg hr^{-1} were significantly underrepresented in FEAST simulations, meaning that critical reevaluation may be necessary to avoid promulgating final rules that incorrectly represent the efficacy of different detection sensitivity tiers in the alternative emissions monitoring framework. We urge the EPA to compare FEAST simulated leak fields to Bridger's empirical emission rate distribution to correct and validate modeling inputs. This should be done in a publicly transparent process so that stakeholders can help identify pitfalls and have confidence in equivalency determinations.

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Summary of Comment 2.1. We urge the EPA to correct and validate FEAST modeling using the best available data in a publicly transparent process prior to finalizing rules for alternative emissions monitoring.

Comment 2.2. OGI should be compared to alternative emissions monitoring approaches using equivalent definitions of detection sensitivity.

The Proposed Rule enables the application of advanced technologies for regulatory compliance through approval as an alternative test method. Approval is contingent on demonstration that the "technology meets the desired detection [sensitivity] threshold(s) as applied in the field."[14] Bridger encourages technology approval based on field performance and supports detection sensitivities being defined at 90% PoD. In addition, Bridger recommends that inputs used to determine equivalence between emissions monitoring approaches should also represent technology field performance. For OGI, studies under realistic but controlled conditions found that experienced surveyors achieved 90% PoD for ~135 g hr^{-1} emission rates under the study conditions.[11] Meanwhile, less experienced surveyors never achieved 90% PoD at any emission rate studied. The study participants knew that there would be emissions to find and often exhibited a competitive spirit, which is different from field operations. The performance indicators from this study are different from the 60 g hr^{-1} (100% PoD) detection threshold that was used for OGI within the FEAST simulations that supported equivalency demonstration in the Proposed Rule.[13] Updating this input could improve the correspondence between FEAST simulations and the real-world emissions reductions that can be achieved using OGI for emissions monitoring. An empirical study of emissions detected by Bridger's Gas Mapping LiDAR™ (GML) technology estimated that GML detected 18× the volume of emissions detected by OGI,[15] highlighting the importance of accurately representing the field performance of OGI to ensure that different emissions monitoring approaches are evaluated on a level playing field.

Summary of Comment 2.2. We urge the EPA to simulate emissions reductions provided by OGI emissions monitoring programs using inputs that are representative of actual OGI field performance.

Comment Area 3: Periodic Screening Matrix

Comment 3.1. The periodic screening alternative approach should be flexible to address seasonal environmental challenges.

Seasonal environmental conditions need to be considered for emissions monitoring because they can adversely affect methane detection performance. A challenge for many remote sensing technologies is ground snow cover, which reduces light reflectivity at wavelengths used for methane detection. This means that a weaker signal is available for methane sensing. In regions that have snow cover for part of the year, operators using remote sensing technologies for emissions monitoring may need to anticipate periods of time when there is a reduced probability of detecting emissions. Other seasonal environmental challenges may also need to be considered. High winds disperse methane plumes, meaning that lower concentrations of methane are available for detection. Meanwhile, the performance of remote sensing technologies using solar radiation may be degraded during overcast periods. The EPA already provided provisions in the Proposed Rule for seasonal environmental challenges for OGI surveys. I.e., "quarterly monitoring may be waived when temperatures are below 0 degrees Fahrenheit (°F) for two of three consecutive calendar months of a quarterly monitoring period".

The EPA does not specify whether different periodic screening detection tiers can be applied within a single LDAR monitoring plan during different time periods. Doing so would help operators in regions

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with seasonal environmental challenges to achieve regulatory compliance within their LDAR monitoring programs. In this scenario, for intervals when environmental challenges reduce emission detection probability, operators could switch to higher frequency monitoring (i.e. a different monitoring tier). We recommend that the EPA provides clear language in the preamble and regulatory text describing the option to switch between detection sensitivity and frequency tiers of the periodic screening matrix on a quarterly basis. By way of example, for screening complex facilities, during three quarters of the year, a certain technology may be capable of achieving sufficient detection sensitivity to meet the most stringent tier (1 kg hr^{-1}, 90% PoD). But during the fourth quarter, snow cover may only allow 2 kg hr^{-1}. During that quarter, bimonthly (i.e., more frequent) scans could be used to achieve compliance.

As noted above, the Proposed Rule includes an exemption for OGI surveys during extreme cold weather. To develop rigorously performance-based methane monitoring requirements, where exemptions exist for one monitoring approach, these same exemptions should extend to the other monitoring approaches. This results in the cold weather exemption also applying to the periodic screening and continuous monitoring alternative approaches. To remove ambiguity, we ask the EPA to clarify whether "below 0 degrees Fahrenheit (°F)" refers to average temperature or some other metric, and how this is to be determined. In addition, because emissions screening during fugitive emissions monitoring can also be used for compliance verification of zero-emission standards, then compliance verification of these numerical standards should also not be required during the impacted quarter.

Summary of Comment 3.1. To account for seasonal methane detection sensitivity limitations, we urge the EPA to make it clear that detection tiers may be selected on a quarterly basis, and to make emissions screening exemptions consistent across monitoring approaches.

Comment 3.2. The EPA can base emissions monitoring options entirely on their performance.

OGI inspections and M21 are methane emissions screening approaches that would fit into the periodic screening framework in the Proposed Rule. Implementing their use for regulatory LDAR using the same provisions that apply to other methane sensing technologies is consistent with the EPA's goal to approve emissions monitoring options based on their performance. To implement these monitoring approaches in the same systematic manner as other technologies, the EPA would establish a sensitivity/scan frequency tier in the periodic screening matrix that corresponds to the performance of these technologies.

To determine the sensitivity corresponding to OGI and M21, further research may be necessary. Performance needs to be demonstrated through analysis studies representative of field conditions commensurate with the requirements for other monitoring approaches. Although OGI cameras and the detectors used for M21 are highly sensitive, their field performance is subject to environmental conditions, user error, and survey procedures. One research study indicated that surveys completed with a flame ionization detector according to M21 and surveys completed at the same sites with OGI detected a similar volume of emissions,[16] meanwhile another study indicated that existing advanced methane sensing technology detected a greater volume of emissions than OGI indicating the need for more research into the capacity of M21 and OGI to comprehensively identify emissions during field deployment.[15] As previously discussed in Comment 2.2, under simulated field conditions, experienced OGI surveyors reached 90% PoD at ~135 g hr^{-1} (less experienced surveyors had reduced performance; they never achieved 90% POD for any emission rate).

Summary of Comment 3.2. We urge the EPA to implement a fully technology agnostic framework for all emissions monitoring approaches with performance attributes well characterized for field deployment.

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Comment 3.3. The periodic screening tier with 30 kg hr^{-1} detection sensitivity is inconsistent with continuous monitoring action thresholds and too weak to achieve equivalence.

Requirements for continuous monitoring and periodic screening require greater consistency. The Proposed Rule specifies continuous monitoring short term action levels of 14 kg hr^{-1} and 21 kg hr^{-1} for site level emissions at single well sites and more complex sites, respectively. Meanwhile, the periodic screening matrix allows *less frequent* monthly screening (+ annual OGI) using a method that achieves *less sensitive* 30 kg hr^{-1} detection sensitivity (90% PoD). Because continuous monitoring is higher frequency emissions monitoring than monthly screening, the 30 kg hr^{-1} periodic screening tier provides a less stringent work practice for emissions reduction. Because different options for emissions monitoring work practices should achieve equivalent levels of emissions reduction, we urge the EPA to remove the 30 kg hr^{-1} detection tier. To Bridger's understanding, all commercial airborne remote sensing methane detection technologies are capable of achieving 10 kg hr^{-1} (90% probability of detection) including sensing technologies deployed from a high-altitude aerial platform as described in Reference 17. Removing the poorest sensitivity (30 kg hr^{-1}, monthly scans) option would therefore not exclude any current commercial airborne technology class.[17]

It must also be noted that the efficacy of the 30 kg hr^{-1} detection tier will be reduced in less heavy-tailed basins than the Permian. The EPA evaluated detection sensitivity tier equivalence using a large emitter emission rate distribution measured in the Permian Basin where large emissions represent an outsized share of cumulative emissions. However, when comparing a basin with a less heavy-tailed emission rate distribution to a basin with a more heavy-tailed distribution like the Permian (Figure 2), it is clear that emissions above 30 kg hr^{-1} represent a much smaller percentage of emissions and significantly fewer emissions reductions will be achieved using this detection sensitivity tier. This phenomenon is accentuated at higher detection tiers such as 30 kg hr^{-1} compared to lower detection tiers.

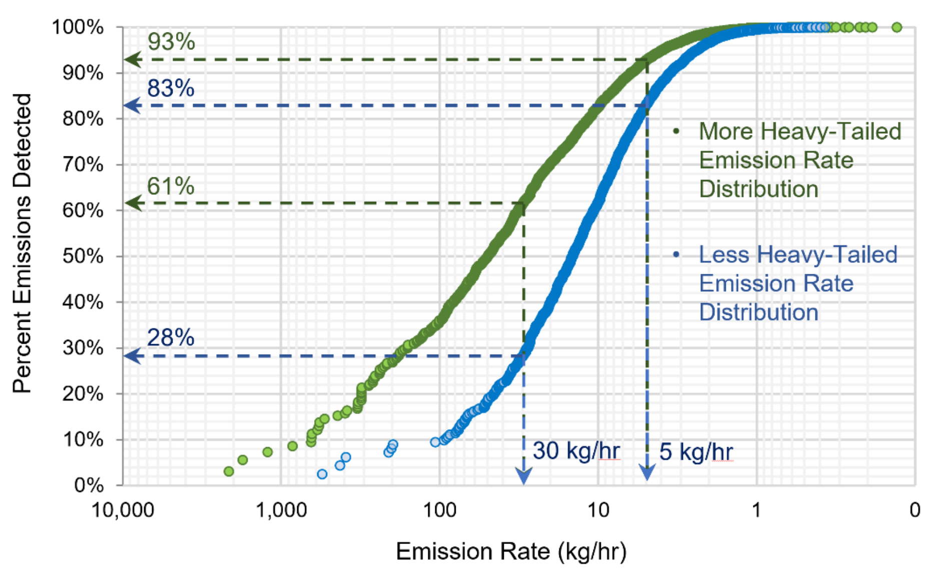

Figure 2. Cumulative emission rate distributions measured by GML in two different North American production basins. The percent of total measured emissions that had rates above 30 kg hr^{-1} is significantly greater in the basin with a more heavy-tailed emission rate distribution compared to the basin with a less heavy-tailed distribution. The difference in percent measured emissions above a given emission rate is smaller for lower emission rates.

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Summary of Comment 3.3. To resolve the inconsistency between the continuous monitoring sensitivity requirements (14 or 21 kg hr^{-1} short-term action levels) when compared to monthly periodic screening with 30 kg hr^{-1} detection sensitivity, and to account for the variation in basin-specific emission rate distributions, we urge the EPA to remove the 30 kg hr^{-1} periodic screening detection tier.

Comment Area 4: Recommended Aspects of the Alternative Test Method Application

Comment 4.1. Third-party blind testing using standard protocols is necessary to provide confidence in the capabilities of methane sensing technologies.

To ensure that the alternative test method approval process is transparent and upholds high scientific standards, blind testing by an approved third party should be required to demonstrate detection sensitivity. The METEC Advancing Development of Emissions Detection (ADED) initiative[d] provides defined blind testing protocols for both continuous emissions monitoring systems and periodic screening methods. Adhering to ADED protocols presents an opportunity to achieve consistent and transparent technology approval.

Summary of Comment 4.1. We urge the EPA to require methane sensing technologies specified in alternative test method applications to demonstrate detection sensitivity performance through third-party blind testing using ADED protocols as part of approval requirements.

Comment 4.2. Emission source localization capabilities should be demonstrated in the alternative test method application.

Fundamental properties of methane sensing technologies include the ability to detect, localize, and quantify emissions. Localization capabilities should guide operators' response to detection events. Efficiency is gained by being able to quickly confirm the presence of an emission, determine its cause, and initiate a response. In Comment 1.2, we urged the EPA to require onsite OGI follow up for periodic screening detection events only within the localization uncertainty of the methane sensing technology. Doing so requires localization precision and accuracy to be parameterized in the alternative test method application. Technologies used for periodic screening of emissions or continuous monitoring at individual well sites, compressor stations, and centralized production facilities should be able to localize emissions at least to the site level. Improved localization capabilities should be reported as equipment group, equipment unit, and component-level precision. These designations have been accepted by the community[8–10] and should simplify onsite follow-up for detected emissions. For example, it would be simpler to use OGI to inspect an equipment group than determine a circle with a 50-foot radius that needs to be inspected. The ADED protocols that are mentioned throughout this letter provide a consistent and transparent approach to evaluating localization precision and accuracy. For a test method to be classified at a given level of localization precision, 95% of its detections should be correctly localized.

Summary of Comment 4.2. We urge the EPA to require demonstration of emission source localization capabilities for methane sensing technologies specified in alternative test method applications through third-party blind testing using ADED protocols.

Comment 4.3. Methane sensing technologies need to reliably quantify emissions.

In the proposed rules, mass emission rate action levels for the continuous monitoring approach assumes that the methane sensing technology accurately quantifies emissions. For example, if a fixed sensor

[d] https://energy.colostate.edu/metec/aded/

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system used for this approach returns average quantification values that are a factor of two lower than the true value, then the desired emissions reductions will not be achieved. Alternatively, if the quantification values are too high, then operators may waste time addressing negligible emissions. An alternative test method should not be approved by the EPA unless its capabilities are well represented.

Quantification is also crucial for the periodic screening approach because mass emission rates are needed to generate emission rate distributions. These distributions are a powerful tool for auditing the detection sensitivity of alternative test methods during field deployment. In the Supplemental Background Technical Support Document for the Proposed rule, an emission rate distribution is used to model super emitter events. By inspecting the distribution, researchers concluded that there were false negative detections between 5 and 50 kg hr^{-1} based on the low number of detections in this emission rate region.[13] Recently, Bridger released a preprint describing a rigorous statistical analysis of this emission rate distribution which revealed the detection sensitivity that was actually realized.[18] In Comment 4.5, we urge the EPA to audit emission rate distributions to assure stakeholders that alternative test methods achieve stated detection sensitivity. Requiring periodic screening technologies to demonstrate quantification capabilities also provides consistency with requirements for continuous monitoring technologies.

The ADED protocols referenced in Comment 4.1 provide standard protocols for evaluating the quantification performance of periodic screening methane sensing technologies and continuous monitoring systems. The EPA should require alternative test method applicants to demonstrate quantification through third party testing using these protocols to provide consistency and transparency.

Summary of Comment 4.3. We urge the EPA to require demonstration of emission rate quantification capabilities for technologies specified in alternative test method applications through third-party blind testing using ADED protocols.

Comment 4.4. Meaningful detection sensitivity performance metrics should be required for continuous monitoring systems.

The Proposed Rule indicates that the detection sensitivity of continuous monitoring systems should be an order of magnitude smaller than the action levels specified for the continuous monitoring approach. However, the performance metric for sensitivity is not defined. We recommend that detection sensitivity is defined as the emission rate at which the technology has a 90% probability of detecting emissions, consistent with the requirements for periodic screening technologies. Using minimum detection levels is not suitable because it may have little bearing on field performance. Detection probabilities for continuous monitoring systems have already been evaluated by a third party, which illustrates that this is a practical requirement.[10]

The demonstration of detection probabilities should be applicable to sites where the continuous monitoring technology will be deployed to ensure that systematic false negative detections do not occur due to exceedingly sparse spatial coverage (e.g., lofted emissions from tanks or flares could be missed and very specific sensor configurations and numbers may be required at individual facilities;[19] certain wind angles and speeds may be necessary for these systems to appropriately detect, quantify, and localize emissions).

Summary of Comment 4.4. For consistent and meaningful performance demonstration, we urge the EPA to require continuous monitoring systems to report their detection sensitivity at 90% probability of detection.

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Comment 4.5. To provide stakeholders with assurance that emission monitoring achieves stated performance, monitoring methods should be routinely audited.

Operators, the EPA, and other stakeholders need assurance that emissions monitoring approaches continue to achieve their stated detection sensitivity. We recommend that the EPA requires sensor operators to report anonymized emission rate measurements in the aggregate for each production basin on a yearly basis (past measured distributions should be a necessary, but not sufficient, requirement of approval). Reporting data for each basin individually is important because different basins can have very different characteristics including emission rate distributions, wind speeds, ground reflectivity, topography, and vegetation. After compiling data obtained from individual alternative test methods and generating emission rate distributions, statistical analysis can be performed to evaluate the detection sensitivity that was achieved during field operations.

Measured emission rate distributions in a production basin can be fit to a suitable model probability density function (e.g., functions describing lognormal or pareto distributions). At lower emission rates, where the number of emissions measured is less than the number expected based on the model probability density function, false negative detections are likely. The fit should only be applied to the part of the emission rate distribution for which the test method has a nearly 100% probability of detecting emissions. Bridger recently released a preprint of a scientific study where we performed similar statistical analysis of emission rate distributions.[18] We refer the EPA to this publication for important details on the analytical approach.

A statistical test on aggregate emission rate distributions is well suited for assessing detection sensitivity field performance for periodic screening approaches because it is simple and objective. Continuous monitoring systems may require alternative statistical analysis, but by collecting data, the EPA, operators, and other stakeholders will have the requisite inputs to objectively evaluate continuous monitor performance even if the analytical methods remain to be established.

Summary of Comment 4.5. We urge the EPA to audit the detection sensitivity achieved during field measurements taken by methane sensing technologies under approved alternative test methods. Next, we recommend that the EPA requires sensor operators to report aggregate emission rate distributions which the EPA would use to evaluate the detection sensitivity achieved during field deployment on a yearly basis.

Comment Area 5: Additional Points That Need Clarification

Comment 5.1. Further clarity is needed to indicate that alternative test methods can be used in the place of both OGI *and AVO* inspection requirements.

It is our understanding that it is the EPA's intent to enable both the periodic screening and continuous monitoring alternative approaches to replace both OGI and AVO inspection requirements for any affected well site, compressor station, or centralized production facility. However, this provision was difficult to understand in the Proposed Rule preamble. We ask the EPA to make this provision clear throughout the preamble and regulatory text.

Summary of Comment 5.1. We urge the EPA to make it clear throughout the preamble and in the regulatory text that periodic screening and/or continuous monitoring alternatives may replace both OGI *and AVO* inspection requirements in fugitive programs.

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Comment 5.2. Further clarity is needed to indicate that alternative test methods can be used for zero emission standard compliance verification for *any* zero-emission affected facility at well sites, compressor stations, and centralized production facilities.

It is our understanding that it is the EPA's intent to enable both the periodic screening and continuous monitoring alternative approaches to provide compliance verification of zero emission numerical requirements for any affected facility at any well site, compressor station, or centralized production facility. However, this provision was difficult to understand in the Proposed Rule preamble. We ask the EPA to make this provision clear throughout the preamble and regulatory text.

Summary of Comment 5.2. We urge the EPA to make it clear throughout the preamble and in the regulatory text that both periodic screening and continuous monitoring alternatives can be used instead of OGI for compliance verification of *any* zero emission requirements for affected facilities at well sites, centralized production facilities, and compressor stations.

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