REGULATORY BEST PRACTICES FOR VENTED AND LEAKED METHANE EMISSIONS FROM UPSTREAM OIL AND GAS OPERATIONS

Input provided to the British Columbia Oil and Gas Commission methane regulatory development process

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DAVID SUZUKI FOUNDATION
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EXECUTIVE SUMMARY

BRITISH COLUMBIA IS FACING A CHOICE. In April 2018, the Government of Canada published regulations to reduce methane emissions by at least 40 to 45 per cent by 2025 and called on provinces to either adopt the federal regulations or develop their own to achieve equivalent reductions. This matters because methane is one of the most harmful climate pollutants, and research shows emissions have been consistently underreported. Furthermore, these emissions have been exempt from policies and regulations such as the carbon tax that are applied to other industries and households to reduce their impact on the climate.

The B.C. government has stated its intention to meet the methane pollution reduction goal through strong regulations. However, to follow through on its commitment, the province must adopt best practice regulations from jurisdictions that have successfully taken action on methane pollution. By taking this approach, B.C. can implement one of the cheapest, most effective climate solutions.

To follow through on its commitment, the province must adopt best practice regulations from jurisdictions that have successfully taken action on methane pollution.

Methane matters

- Methane is an extremely potent greenhouse gas that traps 84 times more heat than carbon dioxide in the atmosphere over a 20-year time frame.
- Recent peer-reviewed research has demonstrated that the volume of methane emissions in B.C. is at least 2.5 times greater than previous provincial government estimates.
- Reducing methane pollution is the most inexpensive and effective action the B.C. government can do to take action on climate change.
- Most methane emission reductions can be achieved at net-zero cost to industry by trapping and selling gas that would otherwise be released to the atmosphere or destroyed through flaring.
- Other jurisdictions, including many U.S. states and Mexico, have shown that strong regulations to reduce methane pollution can be implemented while simultaneously growing the oil and gas industry.
- B.C. should not follow the example set by Alberta through its recent regulations, which do not achieve targets set by the federal government.

Recommendations

To successfully reduce methane pollution in line with federal and provincial targets, B.C. should adopt world-class regulations that:

- Require quarterly leak detection and repair.
- Offer incentives for operators to implement continuous monitoring.
- Reduce and eliminate intentional methane venting.
- Prioritize gas capture and utilization over destruction (i.e., flaring).
- Require zero-bleed, non-emitting equipment where possible.
- Require vapour collection and recovery.
- Require regular replacement of parts known to leak when worn.
- Require regular and transparent inspections, with thorough and transparent record-keeping and public reporting.

INTRODUCTION

British Columbia faces a critical moment in determining whether it will reclaim its international reputation as a climate action leader. Following the leadership of the federal government and other forward-thinking jurisdictions, B.C. has committed to reduce fugitive and vented methane emissions by at least 40 to 45 per cent by 2025. To achieve this target, the province is taking the two-pronged approach of developing regulations for the oil and gas industry while also committing to apply its carbon tax to these emissions for the first time, requiring polluters to pay for emissions of this potent greenhouse gas. For this approach to be successful, B.C. must implement a global best practice regulatory framework. This report seeks to inform that framework by reviewing the significance of methane emissions, key best practices with examples from the United States and a comprehensive review of best-in-class methane emissions regulations.

The current B.C. government has demonstrated its strong commitment to reducing methane emissions from the oil and gas sector, including application of the carbon tax to fugitive and vented emissions as outlined in the confidence and supply agreement with the B.C. Green Party[1] and mandate letters to the respective ministers.[2]

In 2008, when B.C.'s carbon tax went into effect, the provincial government planned for methane pollution from the oil and gas sector to be priced through industry participation in the Western Climate Initiative's cap and trade program. Producers would have to buy permits to cover their emissions. Government, however, failed to translate this intention into an actual legal requirement for industry. While ordinary British Columbian residents and small businesses have been paying a carbon tax on their greenhouse gas emissions for over a decade, the oil and gas industry has had a free ride with regard to methane, a greenhouse gas 84 times more potent than carbon dioxide over a 20-year time frame.

The arguments for effective action are compelling and numerous: the volume of fugitive methane emissions has not been accurately measured; the actions needed to reduce these emissions are low cost; and trapping methane—the main ingredient in natural gas—would benefit industry by providing a sellable resource. Fairness requires that industry finally be required to do its part. Acting now to put in place effective regulations that require leak detection and repair, the use of zero-bleed controllers, etc. will

1 http://bcndpcaucus.ca/wp-content/uploads/sites/5/2017/05/BC-Green-BC-NDP-Agreement_vf-May-29th-2017.pdf
2 Example: https://www2.gov.bc.ca/assets/gov/government/ministries-organizations/premier-cabinet-mlas/minister-letter/heyman-mandate.pdf

foster greater public confidence in the reported volumes of emitted gas and ensure the carbon tax can be applied appropriately to further encourage reductions.

The Government of Canada recently finalized its own regulations to reduce fugitive methane emissions from oil and gas. Provinces can choose to adopt these regulations or draft their own to meet or exceed the stated targets. The Canadian regulations generally meet best practices for methane emissions reductions, including frequent leak detection and repair, site-specific venting limits and transition to low-emitting equipment.

Provincial government attempts to draft equivalent regulations have so far failed. In spring 2018, the Alberta government proposed a set of regulations that were widely regarded as inadequate compared with the federal standard.[3] The weakness of the Alberta regulations stands in stark contrast to the example set in the United States, where state governments have shown that strong methane regulations are compatible with a successful, growing industry. To achieve the emissions reduction target and maintain federal equivalency, B.C. must follow the guidance of the federal regulations and best practices from its U.S. neighbours.

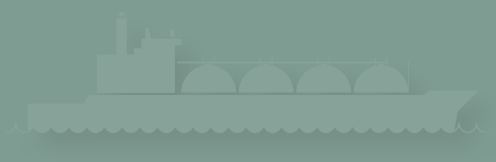
British Columbian residents and small businesses have been paying a carbon tax on their greenhouse gas emissions for over a decade, the oil and gas industry has had a free ride with regard to methane, a greenhouse gas 84 times more potent than carbon dioxide over a 20-year time frame.

The oil and gas industry has often used competitiveness concerns to seek weakened regulations, as it did with recent Canadian federal methane regulations. In fact, Canadian jurisdictions are playing catch-up with U.S. states, which have reduced wasted methane, created jobs and improved air quality for the people and communities working at or near oil and gas facilities. Leading industry players have also announced commitments to dramatically reduce methane emissions. On September 17, 2018, Royal Dutch Shell announced it would maintain methane emissions intensity below 0.2 per cent by 2025.[4] If this emissions rate were replicated across the oil and gas sector, this would considerably outperform Canada's 45 per cent by 2025 commitment.

Moving forward with regulations that utilize best practices, including quarterly LDAR, transitioning to zero-bleed equipment, and prioritizing gas capture over destruction (i.e., flaring), will ensure that B.C. meets its greenhouse gas reduction target and takes its place as a leader in methane reduction policies. In addition, implementing robust monitoring and reporting that prioritizes actual measurement over engineering calculations will help provide more accurate information regarding emissions that can be evaluated and used to effectively apply the carbon tax.

An in-depth U.S. methane regulations best practices compendium is provided in Appendix 1.

3 https://d36rd3gki5z3d3.cloudfront.net/wp-content/uploads/2018/05/Joint-ENGO-AER-Methane-Submission.pdf
4 https://www.shell.com/media/news-and-media-releases/2018/shell-announces-methane-emissions-intensity-target.html



WHY METHANE MATTERS

Methane is a powerful greenhouse gas and the primary component of natural gas. Methane in the atmosphere traps 84 times more heat than carbon dioxide over a 20-year time frame. Methane is responsible for approximately 25 per cent of the climatic changes we feel today. These facts make near-term methane reductions a necessary element of international efforts to battle climate change.

B.C. has recognized the need to reduce methane emissions for more than a decade, with little to show for it. The B.C. energy plan of 2007 "committed to eliminate all routine flaring at oil and gas producing wells and production facilities by 2016."[5]

It is strange that government and industry have not acted more quickly to address methane emissions, as actions that eliminate or reduce methane losses to the atmosphere are highly cost-effective. More natural gas kept in pipelines translates into higher industry profits. The International Energy Agency has found that half or more of global oil and gas methane emissions can be reduced at no net cost.[6] By the end of this century, that level of reduction would be equivalent to immediately closing all of China's coal-fired power plants. That's a huge win for the climate at almost no cost. Research focused on the Canadian oil and gas sector has demonstrated that 45 per cent of emissions could be mitigated at less than $3 per tonne CO2e.[7]

Reducing methane pollution also results in significant air quality and health benefits. Leaks are rarely of pure methane. They frequently contain other pollutants, including air toxins and smog-forming compounds that contribute to harmful air. Smog, or ground-level ozone, is caused by the reaction of volatile organic compounds with oxides of nitrogen in the presence of sunlight. Reducing methane emissions through frequent inspections and leak repairs reduces VOCs — and therefore smog — and air toxins as a co-benefit. Thus, reducing methane emissions also helps achieve public health wins.

5 Province of B.C. (2007). The BC Energy Plan. https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/electricity-alternative-energy/bc_energy_plan_2007.pdf

6 IEA Energy Outlook 2017, http://www.iea.org/publications/freepublications/publication/WEO2017Excerpt_Outlook_for_Natural_Gas.pdf

7 ICF International. (2015). Economic Analysis of Methane Emission Reduction Opportunities in the Canadian Oil and Natural Gas Industries. Environmental Defense Fund.

In jurisdictions across North America and beyond, recent scientific research has demonstrated methane emissions from the oil and gas sector have been systematically underreported in official inventories.[8] A 2017 peer-reviewed study by the David Suzuki Foundation and St. Francis Xavier University found that methane emissions from B.C.'s oil and gas industry are at least 2.5 times higher than reported by industry and government.[9] This study provided the most comprehensive survey ever completed, sampling more than 1,600 individual facilities and sites in B.C.'s Montney Basin, a region that accounts for 55 per cent of gas production in the province.

In Canada, there have been few enforcement actions for failing to meet the existing, relatively lax, regulatory requirements related to methane emissions. The fact that such a high proportion of the oil and gas sector's methane emissions are unmeasured or underreported underlines the importance of implementing effective regulations.

EXAMPLES FROM THE UNITED STATES

A number of U.S. states have implemented methane emissions regulations that provide benchmarks for B.C. Jurisdictions such as California, Colorado, Ohio, Pennsylvania and Wyoming have established regulatory best practices in areas such as quarterly LDAR, transition to zero-emissions equipment or designs, capture and conservation of gas, strict prohibitions on unintentional venting, and monitoring, record-keeping and reporting to aid compliance. These regulations have effectively reduced emissions while allowing for robust oil and gas industries in these states.

Best practice: **quarterly leak detection and repair**

The latest science[10] confirms that leaks and equipment failures are pervasive and random, resulting in significantly higher emissions than regulators and governments tend to estimate.[11] Leaks and failures

8 Höglund-Isaksson, L. (2017). Bottom-up simulations of methane and ethane emissions from global oil and gas systems 1980 to 2012. *Environmental Research Letters*, *12*(2), 024007.

Johnson, M. R., Tyner, D. R., Conley, S., Schwietzke, S., & Zavala-Araiza, D. (2017). Comparisons of Airborne Measurements and Inventory Estimates of Methane Emissions in the Alberta Upstream Oil and Gas Sector. Environmental Science & Technology, 51(21), 13008–13017. https://doi.org/10.1021/acs.est.7b03525

Zavala-Araiza, D., Herndon, S. C., Roscioli, J. R., Yacovitch, T. I., Johnson, M. R., Tyner, D. R., … Knighton, B. (2018). Methane emissions from oil and gas production sites in Alberta, Canada. Elementa Science of the Anthropocene, 6(1). https://doi.org/10.1525/elementa.284

9 Atherton, E., Risk, D., Fougère, C., Lavoie, M., Marshall, A., Werring, J., … Minions, C. (2017). Mobile measurement of methane emissions from natural gas developments in northeastern British Columbia, Canada. *Atmos. Chem. Phys.*, *17*(20), 12405–12420. https://doi.org/10.5194/acp-17-12405-2017

10 Alvarez, R. A., Zavala-Araiza, D., Lyon, D. R., Allen, D. T., Barkley, Z. R., Brandt, A. R., … Hamburg, S. P. (2018). Assessment of methane emissions from the U.S. oil and gas supply chain. *Science*, *361*(6398), 186–188. https://doi.org/10.1126/science.aar7204

11 Atherton, E., Risk, D., Fougère, C., Lavoie, M., Marshall, A., Werring, J., … Minions, C. (2017). Mobile measurement of methane emissions from natural gas developments in northeastern British Columbia, Canada. *Atmos. Chem. Phys.*, *17*(20), 12405–12420. https://doi.org/10.5194/acp-17-12405-2017

are impossible to predict. They occur on a variety of devices, at old and new sites, conventional and unconventional. Much of the emissions associated with oil and gas production come from super emitters. Abnormal process conditions at 20 per cent of sites are responsible for three quarters of emissions in the U.S. Furthermore, emissions from oil and gas facilities are poorly correlated with production levels. This implies that even suspended wells, marginal wells or processing facilities with low production volumes may be leaking significant quantities of methane.[12] Finally, monitoring studies and LDAR programs have found that in many basins, tanks can be a significant source of emissions.

As a result, regular LDAR is critical for any effective fugitive methane emissions regulatory regime. Ultimately, effective, sensitive and continuous on-site monitoring would most effectively identify and address leaks. Low-cost, continuous monitors are being deployed or piloted in a handful of locations in the U.S., and we are optimistic that eventually this technology will become widely available. Until that

Jurisdictions such as California, Colorado, Ohio, Pennsylvania and Wyoming have established regulatory best practices in areas such as quarterly LDAR, transition to zero-emissions equipment or designs, capture and conservation of gas, strict prohibitions on unintentional venting, and monitoring, record-keeping and reporting to aid compliance.

time, at least quarterly LDAR using adequate monitoring instruments such as optical imaging across all well, compression and processing facilities is needed to achieve emissions reductions and protect communities near oil and gas development from leaks from these facilities.

California, Colorado, Ohio, Pennsylvania and Wyoming all require quarterly LDAR in some form. The Canadian federal regulations require LDAR inspections three times a year for most sites, accounting for specific challenges with winter conditions in Canada.

Best practice: **zero-emissions equipment**

Equipment designed to release gas is pervasive in the upstream oil and gas industry. For example, most sites use pressurized natural gas (rather than electricity or compressed air) to open and close valves automatically and operate some pumps. Advances in technology and implementation of robust pollution-prevention rules have resulted in the development of zero-emitting equipment and facility designs. Many types of equipment traditionally powered by pressurized gas can now be powered by renewable or grid energy or compressed air, even at remote sites, eliminating emissions and lowering maintenance costs.

California requires that continuous-bleed pneumatic controllers and pneumatic pumps must not vent to the atmosphere, requiring no-bleed equipment where grid or renewable electricity is available or vapour

12 Alvarez et al. (2018), cited above and Kang, M., Christian, S., Celia, M. A., Mauzerall, D. L., Bill, M., Miller, A. R., ... Jackson, R. B. (2016). Identification and characterization of high methane-emitting abandoned oil and gas wells. *Proceedings of the National Academy of Sciences*, *113*(48), 13636. https://doi.org/10.1073/pnas.1605913113

collection where it's not. The one exception is continuous-bleed controllers that predate the regulation. These devices must be carefully monitored under California's rules. Emphasis is also placed on ensuring that intermittent bleed controllers do not vent when idle, and that all controllers and vapour recovery systems are inspected as a component of LDAR. The Environmental Protection Agency has required that new controllers at gas plants be zero-bleed since 2012, in recognition of the fact that gas plants have access to electricity.

Best practice: **conservation of natural gas instead of destruction**

Traditionally, regulators have allowed operators to flare gas as a way of minimizing vented emissions. During well completions, for instance, fluids may be produced at a high rate to clear the well bore, and unless this gas is conserved, a substantial volume of methane is either released to the atmosphere or destroyed through flaring.

Increasingly, however, leading regulations require operators to prioritize capture and conservation of emissions over destruction. In many cases, capturing these emissions results in a net positive benefit for the operator.

For example, California requires operators to route captured emissions to sales, fuel gas or use for enhanced oil recovery as a first compliance option. California allows for flaring only where capture and use is infeasible.

Last year, the U.S. Bureau of Land Management finalized similar conditions, requiring operators to capture a certain amount of associated gas co-produced from oil wells. The amount of gas that must be captured increases over time, to allow operators to install gas pipelines or on-site recovery and use equipment.

The BC Oil and Gas Commission has the stated goal of reducing the volume of gas that is flared or vented by the upstream oil and gas industry. While it has provided guidance to industry to reduce both venting and destruction through its "Flaring and Venting Reduction Guideline,"[13] best practice involves setting out requirements in enforceable regulations.

Best practice: **robust monitoring and reporting**

Regulations are only as effective as the monitoring and enforcement used to ensure that operators comply. Accountability is achieved through regular and transparent inspections, record-keeping and reporting. As an example, Colorado achieves this accountability through inspections and annual reporting accompanied by a certificate of compliance. Other jurisdictions, such as California, have created incentives to move from regular spot monitoring to continuous monitoring.

Open reporting of compliance with regulations and measured emissions would level the playing field for industry while providing improved information on emissions and activity that will help support effective implementation of the carbon tax.

13 "Flaring and Venting Reduction Guideline" VERSION 5.1: May 2018 https://www.bcogc.ca/node/5916/download

LESSONS FROM OTHER JURISDICTIONS

The following sections outline regulatory approaches to methane pollution undertaken in Alberta and Mexico, respectively. These summaries are meant to compare an ineffective strategy (Alberta's) with one that can serve as a guide for the government of B.C. in developing its own regulations (Mexico's). While it may be tempting to look to Alberta's draft regulations as a suitable foundation document when creating a regulatory framework for B.C. due to geographic proximity, similarity in gas field topography and the fact that the two provinces are subject to the same federal equivalency standards, Mexico's strategy is the more effective one. If B.C. wants to achieve equivalency (at minimum) with the Canadian federal regulations for methane emissions, it must avoid the pitfalls and lack of ambition inherent in Alberta's proposal.

Alberta

Alberta does not provide an adequate regulatory model for British Columbia to follow.[14] Current Alberta regulations will not meet the 45 per cent oil and gas methane-reduction target and fail to meet equivalency with the federal standard. The regulations also lack robust and transparent measurement, monitoring and reporting that would allow regulators and the public to ensure industry is meeting its obligations under the rules. The Alberta regulations also miss important and easy methane reductions while giving industry leeway to continue venting harmful emissions.

Our analysis of Alberta's regulations shows that:

1. Real reductions of methane in Alberta could be closer to 20 per cent than the 45 per cent goal once recent peer-reviewed evidence of under-reporting of venting and leaks is taken into account. Alberta's draft regulations are not even half as strong as they should be.
2. The lack of robust measurement, monitoring and reporting would allow industry to take credit for actions that regulators cannot confirm, undermining the credibility of the rules and provincial claims of emissions reductions.
3. Key provisions, especially leak detection and repair provisions and venting limits, are much weaker in the draft directive than in the Environment and Climate Change Canada rules. Alberta's approach does not meet the equivalent environmental outcome standard under the Canadian Environmental Protection Act.
4. If the federal government allows these weak draft directives to move forward, the federal methane reduction goal will likely not be met.

14 https://d36rd3gki5z3d3.cloudfront.net/wp-content/uploads/2018/05/Joint-ENGO-AER-Methane-Submission.pdf

The oil and gas sector is Alberta's largest methane source, accounting for 70 per cent of provincial methane emissions. Nearly half (48 per cent) of these reported emissions come from venting while another 46 per cent comes from leaks. Oil and gas activities are also significant emitters of VOCs.

Current Alberta regulations will not meet the 45 per cent oil and gas methane-reduction target and fail to meet equivalency with the federal standard.

Multiple peer-reviewed studies show that methane emissions in Alberta are significantly higher than what industry is reporting.

To be credible, achieve the emissions reduction target and maintain federal equivalency, B.C. should be guided by the federal regulations and best practices from U.S. neighbours rather than Alberta.

Mexico

Mexico joined Canada and the United States in calling for a 40 to 45 per cent reduction in methane emissions from its oil and gas sectors by 2025, and recently released draft regulations to meet that target.

Initial analyses[15] suggest that these regulations have the potential to meet this target and are similar to, and in some ways better than, the Canadian regulations. Other analysis also shows that, similar to Canada, methane emissions can be cut by more than half in Mexico with no net cost.[16]

The Mexican regulations include:

- Quarterly comprehensive leak detection and repair.
- Replacement or installation of zero-emitting venting equipment.
- Prioritization of capture technologies over destruction to control emissions from tanks and other equipment.
- A high standard of monitoring and reporting.

Rapid implementation of these regulations is needed to achieve the stated target. Like the states of Colorado and California, Mexico provides a much better regulatory guide for British Columbia than does Alberta.

15 https://www.edf.org/sites/default/files/documents/MX%20Methane%20Regs_FactSheet_English.pdf
16 https://www.edf.org/energy/mexicos-opportunity-cut-oil-and-gas-methane

CONCLUSIONS AND RECOMMENDATIONS

Methane is a potent greenhouse gas, and research has documented that emissions from the oil and gas sector in B.C. are much greater than reported. Several studies, including the federal methane regulations analysis by Environment and Climate Change Canada,[17] have documented that mitigating these emissions is one of the most cost-effective and high-impact climate actions available. Jurisdictions that have implemented strong methane regulations have found that that the sector remains financially viable. British Columbia has committed to taking climate leadership and needs strong and effective regulations that address methane emissions.

Alberta's draft methane regulations do not provide a suitable reference point for developing British Columbia's regulations. Instead, the province should look to regulations in Colorado, California and Mexico as well as the compendium of best practices included in the appendix.

To ensure that B.C. meets its greenhouse gas reduction targets, improves air quality and takes its place as a leader in methane reduction policies, we recommend the following best practices:

- Quarterly leak detection and repair.
- Incentives for operators to implement continuous monitoring, as technology evolves.
- Reduce and eliminate the intentional venting of methane.
    - In the case of oil production facilities that co-produce gas and that currently flare or emit methane, require that the operators capture a proportion that grows over time, incentivizing operators to install gas pipelines or on-site recovery and use equipment.
- Gas capture and utilization over destruction (i.e., flaring).
- Require that equipment traditionally powered by pressurized gas be replaced with zero-bleed equipment (powered by renewable or grid energy or compressed air).
- Require vapour collection and recovery.
- Require regular replacement of parts known to leak when worn (e.g., replacing reciprocating compressor rod packings).
- Regular and transparent inspections, with thorough and transparent record-keeping and public reporting.

17 https://www.canada.ca/en/environment-climate-change/news/2018/04/federal-methane-regulations-for-the-upstream-oil-and-gas-sector.html

APPENDIX 1

United States federal and state-level fugitive methane emissions regulations

Prepared by Elizabeth Paranhos, outside counsel for Environmental Defense Fund

The following memorandum represents a compendium of the best U.S. state and federal requirements to limit methane emissions from new and existing onshore oil and gas activities and equipment. We have not attempted to address every source of methane emissions, but rather have focused on upstream and midstream stationary sources that historically have been the subject of state and federal air pollution regulation. Sources not addressed include flaring of associated gas from oil wells, abandoned and orphaned wells, underground natural gas storage facilities and pipelines, among others. Rather than suggesting regulatory language, this memo highlights the solutions to regulated sources and points to the U.S. regulations that serve as an example of today's leading practices. Footnotes provide citations to the relevant regulatory language.

The requirements apply to:

- new and existing activities or sources, unless otherwise noted.
- activities and equipment in the onshore crude oil and natural gas production and natural gas processing, storage and transmission segments.

"New" activities or sources are those that begin or are constructed after the effective date of the regulation or requirement.

The memorandum lists recommended policies by source.

I. Combustion devices

a. Operational requirements

i. If a flare or other combustion device[18] is used to control emissions of hydrocarbons, it shall be enclosed, be equipped with and operate an auto-igniter, have no visible emissions during normal operations, and be designed so that an observer can, by means of visual observation from the outside of the enclosed flare or combustion device, determine whether it is operating properly.[19]

18 A combustion device means an enclosed device with a design destruction efficiency of at least 98% for hydrocarbons and equipped with an auto-igniter. A combustion device means an enclosed device with a design destruction efficiency of at least 98% for hydrocarbons and equipped with an auto-igniter. Colorado Regulation Number 7, 5 C.C.R. 1001-9, §§ XVII.B.2.b, XVII.B.2d, XVII.D.3, available at https://www.colorado.gov/pacific/sites/default/files/5-CCR-1001-9_0.pdf.

19 *Id.* at § XVII.B.2.b.

b. Monitoring requirements

i. Operation of a combustion device used to control emissions shall be continually monitored using any device that senses and records a parameter that indicates whether the combustion device is functioning to achieve the 98 per cent control requirement.[20]

II. Continuous-bleed pneumatic controllers

a. Control requirement

i. New controllers: Shall not vent to the atmosphere.[21] Operators can meet this requirement by either using no-bleed devices at facilities with access to grid or renewable energy[22] or routing emissions to a vapour collection system[23] that captures the emissions.[24] If it is not feasible to capture the emissions, operators may use a flare.[25]

ii. Existing controllers at production facilities: Require retrofits of existing continuous-bleed controllers such that emissions from all controllers are no-bleed (zero emissions) or must be limited to six standard cubic feet per hour ("low-bleed" levels).[26] If it is not feasible to route the discharge to a vapour collection system operators may route the discharge to a combustion device.[27]

iii. Existing controllers at gas processing plants and compressor stations: Utilize zero bleed.[28]

b. Monitoring

i. Inspect pneumatic devices and vapour recovery system or control device as part of LDAR.[29]

ii. Test low-bleed devices using a direct measurement method to ensure they are not venting gas at a rate greater than six standard cubic feet per hour.[30]

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20 *See* Environmental Protection Agency, Final Rule, Oil and Natural Gas Sector: Emission Standards for New and Modified Sources, 81 Fed. Reg. 35824 (June 3, 2016), 40 C.F.R. § 60.5417a, ("EPA 0000a).

21 California Final Regulation Order, March 25, 2016 ("CARB"), 17 C.C.R. § 95668(e)(2),(5), arb.ca.gov/regact/2016/oilandgas2016/oilgasfro.pdf.

22 *See Id*. at § 95668(e)(5)(A); see also 5 C.C.R. 1001-9, § XVIII.C.2.a (requiring the use of no-bleed controllers wherever "on-site electrical grid power is being used and use of a no-bleed pneumatic controller is economically and technically feasible.").

23 A vapor collection system means equipment and components installed on pressure vessels, separators, tanks, or sumps including piping, connections, and flow-inducing devices used to collect and route emissions to a processing, sales gas, or fuel gas system; to an underground injection well. CARB, 17 C.C.R. § 95667(a)(62) "Vapor collection system" means equipment and components installed on pressure vessels, separators, tanks, or sumps including piping, connections, and flow-inducing devices used to collect and route emission vapors to a processing, sales gas, or fuel gas system; to a gas disposal well; or to a vapor control device.

24 Wyo. Dep't of Envtl. Quality, Oil and Gas Production Facilities: Chapter 6 Section 2 Permitting Guidance (June 1997, Revised May, 2016) ("WY Permitting Guidance"), 11, deq.wyoming.gov/media/attachments/Air%20Quality/New%20Source%20Review/Guidance%20Documents/5-12-2016%20Oil%20and%20Gas%20Guidance.pdf; see also CARB § 95668(e)(5).

25 *Id*.

26 EPA Control Techniques Guidelines for the Oil and Natural Gas Industry ("CTGs"), Oct. 20, 2016, § 6.4, available at https://www.epa.gov/sites/production/files/2016-10/documents/2016-ctg-oil-and-gas.pdf; Bureau of Land Management, Final Rule, Waste Prevention, Production Subject to Royalties, and Resource Conservation ("BLM"), 81 FR 83008, Nov. 18, 2016, 43 C.F.R. § 3179.201(a)(1), file:///Users/Bessie/Downloads/BLM-2016-0001-9126%20(1).pdf; Wyo. Dep't of Envtl. Quality, Air Quality Division, Chapter 8, Nonattainment Area Regulations, Section 6(f), ("Wyoming Nonattainment Area Regulations"), http://soswy.state.wy.us/Rules/default.aspx; CARB, § 95668(e)(2)(A)(1).

27 CARB § 95668(e)(5)(a); Wyoming Nonattainment Area Regulations, Section 6(f).

28 Environment & Climate Change Canada, Proposed Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector) (May 27, 2017), gazette.gc.ca/rp-pr/p1/2017/2017-05-27/html/reg1-eng.php.

29 CARB § 95668(e)(2); see also Colorado Reg. 7, §XVIII.F.

30 CARB § 95668(e)(2).

c. Record-keeping
    i. Documentation of the natural gas bleed rate or, if bleed rate is zero, documentation of the type of pneumatic controller.[31]

d. Reporting
    i. Annual report demonstrating compliance and recording any deviations accompanied by certification of the truth, accuracy and veracity of the report signed by a responsible official.[32]

III. Intermittent vent pneumatic controllers

a. Control requirement
    i. Controllers shall not vent natural gas when idle (not actuating) determined by testing the device when not actuating in accordance with leak detection and repair requirements.[33]

b. Monitoring
    i. Inspect pneumatic devices when not actuating as part of LDAR.[34]

c. Record-keeping
    i. Documentation that the device is not venting when idle and not actuating.[35]

d. Reporting
    i. Annual report demonstrating compliance and recording any deviations accompanied by certification of the truth, accuracy and veracity of the report signed by a responsible official.[36]

IV. Liquids unloading

a. Control requirement
    i. New and existing wells: Require existing wells to use any means of creating differential pressure to unload the liquids from a well without venting.[37] If these methods are not successful in unloading the liquids from the well, the well may be vented to the atmosphere. Operators must remain on-site during any liquids unloading events to ensure that any venting to the atmosphere is limited to no more than what is practically necessary.[38]

b. Record-keeping
    i. Operators must retain records of the cause, date, time, duration and estimated volume of each venting event.[39]

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31 *See* 40 C.F.R. § 60.5390a.
32 *See e.g.*, Wyoming Permitting Guidance (compliance requirements for well blowdown BMP requirements); 40 C.F.R. § 60.5420(c)(1) (EPA requirements for gas well completions); see also Colorado Reg. 7, § XVII.F.9.f.
33 CARB, § 95668(e)(3); Ohio General Permit 18.1.C.1.d.2.b., epa.ohio.gov/dapc/genpermit/ngcs/GP_181.aspx; see also Colorado Reg. 7, §XVIII.F..
34 CARB § 95668(e)(3); Ohio General Permit 18.1.C.1.d.2.b., epa.ohio.gov/dapc/genpermit/ngcs/GP_181.aspx; see also proposed Colorado Reg. 7, §XVIII.F. (October 18, 2017).
35 40 C.F.R. §§ 60.5390(c)(1), 5420(b)(5)(i).
36 Wyoming Oil and Gas Production Facilities Ch. 6, Sec. 2 Permitting Guidance (Nov. 2013) (compliance requirements for well blowdown BMP requirements); 40 C.F.R. § 60.5420(c)(1) (EPA requirements for gas well completions); see also CO Reg. 7, § XVII.F.9.f.
37 Colorado Reg. 7, § XVII.H.1.a; see also BLM, 43 C.F.R. § 3179.204.
38 *Id.*
39 CO Reg. 7, § XVII.H.1.c; 43 C.F.R. § 3179.204(c)(2).

c. Reporting

i. Annual report demonstrating compliance and recording any deviations accompanied by certification of the truth, accuracy and veracity of the report signed by a responsible official.[40]

V. Equipment leaks

a. Applicable to wells, well sites, compressor stations, tank batteries and gas processing plants.

b. Control requirement

i. Immediate inspection after startup, at least within 30 days.[41]

ii. Quarterly inspections[42] of components using an optical gas imaging device or alternative approved device that is equally or more effective at detecting leaks.[43]

1. Components means any component that has the potential to emit fugitive emissions of methane including but not limited to a valve, fitting, flange, threaded-connection, process drain, stuffing box, pressure-vacuum, valve, pipe, seal fluid system, diaphragm, hatch, sight-glass, meter, open-ended line, continuous bleed and intermittent-vent natural gas powered pneumatic device, natural gas powered pneumatic pump, centrifugal compressor wet seal, or reciprocating compressor rod packing or seal, combustion devices and vapour recovery systems.[44]

2. Rule includes robust compliance pathway for evaluating and approving of alternative monitoring technologies such as emerging continuous methane monitors.[45]

iii. Daily audio, visual or olfactory inspections at manned facilities and weekly audio, visual or olfactory inspections at unmanned facilities.[46]

iv. Repair or replace all "fugitive emissions" within five working days of discovery, unless the component is a critical component or unsafe to monitor.[47] If a critical or unsafe to monitor component, operators shall minimize the leak within one day of detection and repair the leak by the end of the next process shutdown or within 12 months, whichever is sooner.[48]

1. Fugitive emissions means any visible emission from a fugitive emissions component observed using optical gas imaging.[49]

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40 *See e.g.*, Wyoming Permitting Guidance (Nov. 2013) (compliance requirements for well blowdown BMP requirements); 40 C.F.R. § 60.5420(c)(1) (EPA requirements for gas well completions); see also Colorado Reg. 7, § XVII.F.9.f.

41 Colorado Reg. 7, § XVII.F.4.a; 40 C.F.R. 60.5397a(f)(1).

42 40 C.F.R. § 60.5397a(g); Colorado Reg. 7, § XVII.F.4.a; CARB § 95669(g); Pa. Dep't of Envtl. Prot., Proposed General Plan Approval And/Or General Operating Permit BAQ-GPA/GP5, Section K ("Pennsylvania General Permit 5"), elibrary.dep.state.pa.us/dsweb/Get/Document-116053/2700-PM-BAQ0267_GP-5%20.pdf; Ohio Envtl. Prot. Agency, General Permit 12.1(C)(5)(c)(2), 12.2(C)(5)(c)(2), epa.ohio.gov/Portals/27/oil%20and%20gas/GP12.1_PTIOA20140403final.pdf; WY Permitting Guidance at 22; Wyoming Nonattainment Area Regulation §(6)(g)(1)(a); Utah Department of Environmental Quality, Division of Air Quality, Approval Order: General Approval Order for a Crude Oil and Natural Gas Well Site and/or Tank Battery, II.B.10 (June 5, 2014), deq.utah.gov/Permits/GAOs/oilgas/oilgasgao.htm.

43 43 C.F.R. § 3179.302(a); 40 C.F.R. § 50.5397a(a)

44 CARB § 95667(a)(9); Ohio General Permit 18.1.C.1.d.2.b.; *see also* 40 C.F.R. § 60.5430a.

45 CO Reg. 7. § XII.L.8.a(ii)(I); CDPHE, *Alternative AIMM Guidance and Procedures*, p. 1 (May 31, 2018) (accessible at https://drive.google.com/file/d/1reFIFX_DVl_Wcu82853NNekmhjOtljui/view).

46 CARB §95669(e).

47 CO Reg. 7, § XVII.F.7.a.

48 CO Reg. 7, § XVII.F.7.a § XVII.F.5.b; § CARB §§ 95669(h)(3). Critical component means component that would require the shutdown of a process unit if component was shut down or disabled. Unsafe to monitor means it is not possible to monitor without exposing operator to immediate danger as a result of monitoring.

49 40 C.F.R. § 60.5397a(a); see also CO Reg. 7, § XVII.F.4.

2. Fugitive emissions means any concentration of hydrocarbon above 500 ppm for any monitoring using approved quantitative instrument based monitoring.[50]

v. Re-monitoring

1. Each repaired or replaced component must be resurveyed as soon as practicable to ensure there is no leak, but no later than 15 days of the leak discovery.[51]

c. Record-keeping

i. Must retain records documenting results of inspections, including identification of number of leaks by component, date of inspection and date of repairs, date of re-monitoring to verify repair, list of unsafe to monitor and critical components on delayed repair list, and plan for monitoring such components.[52]

d. Reporting

i. Must submit annual report including total number of facilities inspected, total number of inspections, total number of leaks identified, by component, total number of leaks repaired, total number of leaks on delayed repair list. Accompanied by certification of the truth, accuracy and veracity of the report signed by a responsible official.[53]

VI. Glycol Dehydrators

a. Control requirement

i. Operators shall control emissions from new and existing glycol dehydrators by 98 per cent.[54]

b. Monitoring

i. Inspect glycol dehydrator and vapour recovery system or control device as part of LDAR.[55]

c. Reporting

i. Annual report demonstrating compliance and recording any deviations accompanied by certification of the truth, accuracy and veracity of the report signed by a responsible official.[56]

50 CO Reg. 7, § XVII.F.6(a).
51 40 C.F.R. § 60.5397a(j)(2).
52 CO Reg. 7, § XVII.F.4.
53 CO Reg. 7, § XVII.F.9.f.
54 WY Permitting Guidance, 25 (requiring all new dehydrators to control emissions by 98%); Wyoming Nonattainment Area Regulations, Section 6(d)(1)(A); CO Reg. 7, § XVII.D.3. Some states set a control threshold below which operators are not required to install controls. This threshold varies, and is dependent on a number of factors including whether or not a control device is already present at the site, the cost of installing a new device, and the emissions potential from the dehydrators.
55 *See* e.g., CARB § 95668(c),(d) (components on driver engines and compressors are subject to LDAR).
56 *See e.g.*, Wyoming Permitting Guidance (compliance requirements for well blowdown BMP requirements); 40 C.F.R. § 60.5420(c)(1) (EPA requirements for gas well completions); *see also* CO Reg. 7, § XVII.F.9.f.

VII. Centrifugal compressor seals

a. Control requirement
   i. New and existing: Require operators to route emissions either to a vapour collection system or combustion device. Alternatively, operators can design the compressor using dry seals.[57]

b. Monitoring
   i. Inspect compressor, wet seals, isolation valves, vapour recovery system or control device as part of LDAR.[58]

c. Reporting
   i. Annual report demonstrating compliance and recording any deviations accompanied by certification of the truth, accuracy and veracity of the report signed by a responsible official.[59]

VIII. Reciprocating compressor rod-packing

a. Control requirement
   i. New and existing: Route emissions from compressor vent stacks used to vent rod packing or seal emissions to a vapour recovery system, or if not feasible, to a combustion device.[60]

b. Monitoring
   i. Inspect compressor, compressor seals, rod-packing and vapour recovery system or control device part of LDAR.[61]

c. Reporting
   i. Annual report demonstrating compliance and recording any deviations accompanied by certification of the truth, accuracy and veracity of the report signed by a responsible official.[62]

IX. Storage tanks

a. Control requirements
   i. Construct tankless facilities.[63]
   ii. Require operators to capture and conserve emissions using a vapour collection system.[64]
   iii. Prohibit venting of hydrocarbon emissions from access points on tanks during normal operation.[65]

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57 CARB § 95668(e)(5); 40 C.F.R. §§ 5380(a)(1)-(2); 5380a(a)(1)-(2).
58 CARB § 95668(d)(3).
59 *See e.g.*, Wyoming Permitting Guidance (Nov. 2013) (compliance requirements for well blowdown BMP requirements); 40 C.F.R. § 60.5420(c)(1) (EPA requirements for gas well completions); *see also* CO Reg. 7, § XVII.F.9.f.
60 CARB § 95668(d)(3)(A),(B); Ohio Envtl. Prot. Agency, General Permit 17.1 Template, available at http://epa.ohio.gov/dapc/genpermit/permitsec.aspx; *See* CARB § 95668(d); *See also* 79 Fed. Reg. 41752 (July 17, 2014) and 40 C.F.R. § 60.5420(c).
61 *See* CARB § 95668(c).
62 *See e.g.*, Wyoming Permitting Guidance (Nov. 2013) (compliance requirements for well blowdown BMP requirements); 40 C.F.R. § 60.5420(c)(1) (EPA requirements for gas well completions); *see also* CO Reg. 7, § XVII.F.9.f.
63 See Boulder County Oil and Gas Regulations, Article 12-701.A.1.e., https://assets.bouldercounty.org/wp-content/uploads/2017/02/land-use-code-article-12.pdf (Providing that the County may require the construction of tankless facilities).
64 CARB, 95668(a)(6). Some states set a control threshold below which operators are not required to install controls. This threshold varies, and is dependent on a number of factors including whether or not a control device is already present at the site, the cost of installing a new device, and the emissions potential from the storage tanks.
65 Other potential language could include "hatches shall be closed at all times except during sampling, adding of process material through the hatch, or attended maintenance operations." Ventura County R. 74.10.C.1.

iv. Require operators of controlled tanks to evaluate their systems for controlling tank emissions and certify that each system is designed to meet the no-venting prohibition.[66]

b. Monitoring
   i. Require at least monthly visual and AVO inspections of tanks and control devices to ensure emissions are being routed to control units and flares are operating as designed.[67]
   ii. Monitor storage vessels, access points and vapour collection system or combuster as part of LDAR.[68]

c. Record-keeping
   i. Retain records of monthly visual and AVO inspections.[69]

d. Record-keeping
   i. Annual report demonstrating compliance and recording any deviations accompanied by certification of the truth, accuracy and veracity of the report signed by a responsible official.[70]

X. Pneumatic pumps

a. Control requirement
   i. New and existing: Use zero-bleed pump or route emissions to vapour collection system.[71]

b. Monitoring
   i. Monitor pump, vapour collection system and combuster as part of LDAR.

c. Reporting
   i. Annual report demonstrating compliance and recording any deviations accompanied by certification of the truth, accuracy and veracity of the report signed by a responsible official.[72]

XI. Open-ended lines and valves and sampling connection system

a. Control requirements
   i. Require each valve or line be equipped with a cap, blind flange, plug or second valve. Alternatively, operators can treat as fugitive components and include in LDAR program.[73]
   ii. Require each sampling connection system to be equipped with a closed-loop, vent or purge system.[74]

66 CO AQCC Reg. 7 § XVII.C.2.
67 *Id.* at § C.1.
68 *Id.* at § C.2.b.
69 *Id.* at §§ XVII.C.4, XVII.F.
70 *See e.g.*, Wyoming Permitting Guidance (Nov. 2013) (compliance requirements for well blowdown BMP requirements); 40 C.F.R. § 60.5420(c)(1) (EPA requirements for gas well completions); *see also* CO Reg. 7 § XVII.F.9.f.
71 43 C.F.R. 3179.202(b); CARB § 95668(e)(4); Wyoming Nonattainment Area Regulation §6(e).
72 *See e.g.*, Wyoming Permitting Guidance (Nov. 2013) (compliance requirements for well blowdown BMP requirements); 40 C.F.R. § 60.5420(c)(1) (EPA requirements for gas well completions); see also CO Reg. 7, § XVII.F.9.f.
73 CO Reg. 7, § XVII.B.3.a.
74 Ohio Envtl. Prot. Agency, General Permit 12.1.C.5.d.3.b, *available at* http://epa.ohio.gov/Portals/27/oil%20and%20gas/GP12.1_PTIOA20140403final.pdf

XII. Compressor venting

a. Control requirements
   i. New: The compressor shall be designed so that no gas from compressor blowdown vents is emitted into the atmosphere. This requirement can be met by a design that captures 100 per cent of the gases from these sources, and routes them to vapour recovery system, or if not feasible, to a combustion device. The above design requirements shall be met at all times that pressure is present at the inlet or discharge isolation valve, including periods of either intermittent or prolonged shutdown of the compressor.[75]

b. Monitoring
   i. Monitor compressor, vapour collection system and combuster as part of LDAR.

c. Record-keeping
   i. Maintain records of the number of blowdown events, volume of gas emitted from all compressor blowdown events for each month, in scf; mole fraction of each CH4 component in the gas stream using a representative analysis; and the rolling, 12-month summation of the volume of gas emitted from all compressor blowdown events, in scf.[76]

d. Reporting
   i. Annual report demonstrating compliance and recording any deviations accompanied by certification of the truth, accuracy and veracity of the report signed by a responsible official.[77]

XIII. Pigging

a. Control requirements
   i. During pigging activities operator must limit methane emissions by using a vapour recovery system, or if not feasible, a combustion device.[78]

b. Record-keeping
   i. Date and time of venting,[79] and amounts of venting.[80]

c. Reporting
   i. Annual report demonstrating compliance and recording any deviations accompanied by certification of the truth, accuracy and veracity of the report signed by a responsible official.[81]

75 *See* Ohio Envtl. Prot. Agency, General Permit 17.1.C.3, epa.ohio.gov/dapc/genpermit/ngcs/GP_171.aspx
76 *See* Ohio Envtl. Prot. Agency General Permit 17.1.C.1.d.2, http://epa.ohio.gov/dapc/genpermit/ngcs/GP_171.aspx
77 *See e.g.*, Wyoming Permitting Guidance (Nov. 2013) (compliance requirements for well blowdown BMP requirements); 40 C.F.R. § 60.5420(c)(1) (EPA requirements for gas well completions); see also CO Reg. 7, § XVII.F.9.f.
78 *See* Ohio Envtl. Prot. Agency General Permit 21.1.C.1.b., epa.ohio.gov/dapc/genpermit/ngcs/GP_171.aspx; *See also* Pennsylvania DEP General Permit 5A.K.
79 *Id.*
80 Wyoming Permitting Guidance (Nov. 2013) (compliance requirements for well blowdown BMP requirements)
81 *See e.g.*, Wyoming Permitting Guidance (Nov. 2013) (compliance requirements for well blowdown BMP requirements); 40 C.F.R. § 60.5420(c)(1) (EPA requirements for gas well completions); see also CO Reg. 7, § XVII.F.9.f.

XIV. Oil and gas well completions and recompletions

a. Control requirements
   i. During the initial flowback stage, the owner or operator of a gas well shall route the flowback into one or more well completion vessels or storage tanks and commence operation of a separator.
   ii. During the separation flowback stage, the owner or operator of a gas well shall route all recovered liquids from the separator to one or more well completion vessels or storage tanks, re-inject the liquids into the well or another well or route the recovered liquids to a collection system. The owner or operator of a gas well shall route the recovered gas from the separator into a gas flow line or collection system, use the recovered gas as an on-site fuel source, or use the recovered gas for another purpose that a purchased fuel or raw material would serve.
   iii. The owner or operator of a gas well shall route all recovered gas to the gas flow line as soon as practicable or shut in and conserved. In cases where recovered gas cannot be directed to the flow line, the owner or operator of a gas well shall capture and direct recovered gas to a combustion device, except in conditions that may result in a fire hazard or explosion, or where high heat emissions from a combustion device may negatively impact waterways.
   iv. The owner or operator of a gas well has a general duty to safely maximize resource recovery and minimize releases to the atmosphere during flowback and subsequent recovery.[82]
   v. Notify appropriate regulator no later than two days prior to the commencement of each well completion operation and provide location of the well and planned date of completion activity.[83]

b. Notification
   i. The owner or operator of an affected gas well subject to this section shall submit a notification to the department no later than two days prior to the commencement of each well completion operation that provides the anticipated date of the well completion, well number and location, owner or operator contact number, and planned date of the beginning of flowback.[84]

c. Record-keeping
   i. A log for each well completion operation at each affected gas well with hydraulic fracturing operations specifying the following: location, date, time and duration of completion, duration of combustion and venting, if any and specific reasons for venting in lieu of capture or combustion.[85]

d. Reporting
   i. Annual report demonstrating compliance and recording any deviations accompanied by certification of the truth, accuracy and veracity of the report signed by a responsible official.[86]

82 40 C.F.R. §§ 60.5375(a)(1)-(4); 60.5375a(a)(1)-(4).
83 *Id.* at §§ 60.5410; 60.5410a
84 *Id.* at §§60.5420(a)(2); 60.5420a(a)(2);
85 *Id.* at §§60.5375(b); 60.5375a(b).
86 *Id.* at §§ 60.5420(c)(1), 60.5420a(c)(1),