





Appendix A: Comparison of Existing and Recommended Pennsylvania Permit Requirements to Standards of the Center for Sustainable Shale Development, Colorado and EPA's Proposed Standards to Reduce Methane and VOC Emissions for the Oil & Natural Gas Sector

December 15, 2015

Well Pad Operations				
Pennsylvania	EPA's Proposed NSPS	Center for Sustainable Shale Development (CSSD) Performance Standards	Colorado	PA Draft Well Pad General Permit (GP) Recommendations
Air Quality Permit Category No 38 Exemption Criteria 25 Pa. Code 127.14 (d) Applicable to new or modified sources since August 10, 2013.	NSPS Subpart OOOOa proposed on August 18, 2015 Applicable to all new hydraulically fractured wells.	Performance standards apply to unconventional exploration, development, and gathering activities including site construction, drilling, hydraulic fracturing and production in the Appalachian Basin.	Regulation Nos. 6 & 7 requires compliance with NSPS requirements in 40 CFR Part 60, Subpart OOOO	Explore the possibility of establishing GP requirements for new conventional wells which are hydraulically fractured.
LDAR: LDAR Program applies to Methane and Volatile Organic Compounds (VOC).	LDAR: LDAR Program applies primarily to VOC emissions with co-benefit methane reductions.	Directed Inspection & Maintenance (DI&M) program for equipment leaks is not compound specific.	LDAR is based on VOC emissions only.	Include LDAR Program requirements applicable to Methane and VOCs in a GP.
A leak is defined as a concentration of 2.5% methane or VOC concentration greater than 500 ppm.	LDAR Program for well production facilities and natural gas compressor stations; leak threshold greater than 500 ppm of VOC.	DI&M defines a leak as fugitive emissions without quantifying the concentration or rate.	LDAR Program for well production facilities and natural gas compressor stations; leak threshold greater than 500 ppm of VOC.	Define a leak as a concentration of 2.5% methane or VOC concentration greater than 500 ppm in a GP.

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Initial Inspection using Forward Looking Infra-Red (FLIR) Camera or approved device - within 60 days after the well is put into production.	✓ Inspection using FLIR Camera or other optical imaging system – no later than 30 days after the well commences operation.	DI&M requires a visual, auditory and olfactory inspection for initial certification. No specific requirement for a FLIR Camera	✓ Inspection using FLIR Camera or other approved device – no sooner than 15 days and no later than 30 days after the well commences operation. Inspections required for existing well sites based on a phase-in schedule.	✓ Inspection using FLIR Camera or other optical imaging system – no later than 30 days after the well commences operation.
After the initial inspection LDAR must be conducted annually.	✓ After the initial inspection LDAR must be conducted semi-annually or annually. The frequency may be decreased to annual for sites with leaks in less than 1% of the components. The frequency may be increased to quarterly for sites with leaks in more than 3% of the components.	✓ DI&M require a visual, auditory and olfactory inspection and on a weekly basis with a yearly mechanical or instrument check to detect leaks. No specific requirement for a FLIR Camera.	After, the initial inspection, additional inspection frequency depends on the amount of VOC emissions from the facility. For example, LDAR inspection required one time if the VOC emissions are less than 6 tons per year. LDAR is required monthly if VOC emissions are greater than 20 tons per year.	✓ Require quarterly LDAR inspections using a FLIR camera or another DEP-approved device for inspections.
No Audio Visual Olfactory (AVO) inspections required.	Audio Visual Olfactory (AVO) inspections required only for tank covers and closed vent system on a monthly basis.	✓ DI&M require a visual, auditory and olfactory inspection and on a weekly basis.	✓ Monthly AVO inspections required.	✓ Require monthly AVO inspections on the entire well site operations.
Leaks are to be repaired no later than fifteen (15) calendar days after leak	Leaks are to be repaired as expeditiously as practicable, but no later than fifteen	Once significant leaks are detected they are required to be repaired in a timely manner.	✓ First attempt to repair a leak must be made no later	✓ Require the first attempt at leak repair within five (5) calendar

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<p>detections unless facility shutdowns or ordering of replacement parts are necessary for repair of the leaks.</p>	<p>(15) calendar days after leak detections unless facility shutdowns or ordering of replacement parts are necessary for repair of the leaks.</p>		<p>than five (5) working days after discovery, unless parts are unavailable. The parts must be ordered promptly and the repair must be made within fifteen (15) working days of receipt of the parts.</p>	<p>days after detecting a leak. If the purchase of parts is necessary, the leak must be repaired within 15 calendar days after receipt of the parts.</p>
<p> Reporting: Compliance Demonstration Reports including LDAR must be submitted to DEP within 180 calendar days after the well completion or installation of a new source.</p> <p>In addition, by March 1st of each year, source reports for all air emissions for the preceding year, including methane emissions, from all unconventional natural gas well sites, must be submitted for the annual emission inventory.</p>	<p>Reporting: The owner or operator of each facility subject to LDAR requirements must submit an annual report.</p>	<p>Performance Standards have no air specific requirement for reporting by the operator.</p>	<p>Reporting: The owner or operator of each facility subject to the LDAR requirements must submit a single annual report on or before May 31st each year.</p> <p>Annual emission reporting does not include greenhouse gas emissions such as Methane.</p>	<p> Reporting: Compliance Demonstration Reports including LDAR inspection results must be submitted to DEP within 180 calendar days after the well completion or installation of a new source.</p> <p>By March 1st each year, Chapter 135 source reports must be submitted to DEP for the annual emission inventory. The reports must include all emissions during the preceding year, including methane emissions, from all unconventional natural gas well sites.</p> <p>The annual report must also include LDAR inspection results.</p>
<p> Storage Tanks Reduce VOC emissions by 95% with the potential to emit 2.7 tpy or greater.</p>	<p>Storage Tanks: Reduce VOC emissions by 95% with the potential to emit 6 tpy or greater. No detectable emissions consistent with the EPA Method 21</p>	<p>Individual storage vessels with VOC emissions equal to or greater than 6 tpy must install controls to achieve at least 95% reduction in VOC emissions</p>	<p>Storage Tanks: No detectable emissions consistent with the EPA Method 21 referenced in EPA's New Source Performance Standard (NSPS) for the Oil & Gas Sector (40</p>	<p> Establish GP requirements for control of air contaminant emissions from storage tanks using air pollution control devices with a control efficiency of 95%.</p>

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	referenced in EPA's New Source Performance Standard (NSPS) for the Oil & Gas Sector (40 CFR Part 60, Subpart OOOOa).		CFR Part 60, Subpart OOOO).	Require operations without venting hydrocarbon emissions from any access point or pressure relief device during normal operation.
Pneumatic controllers: No state specific requirements.	Pneumatic controllers: Natural gas bleed rate no more than 6 scfh (Continuous bleed natural gas-driven pneumatic controllers greater than 6 scfh between wellhead and natural gas processing plant or oil pipeline)	✓ Pneumatic controllers: Must be low—bleed with a natural gas bleed of 6 scfh or less. Requires zero bleed when electricity (3—phase electrical power) is on—site.	✓ All new pneumatic controllers (placed in service after May 1, 2014) must emit an amount less than or equal to a low-bleed controller. No-bleed controllers required used where on-site electrical grid power is accessible. High-bleed controllers in service prior to May 1, 2014 must be replaced or retrofitted such that emissions are less than or equal to a low-bleed controller. All high-bleed controllers that remain in service require approval.	✓ Require no-bleed pneumatic controllers where electricity (grid power) is available and low bleed valves. All pneumatic controllers, other than no-bleed controllers, must be low bleed controllers with a leak rate of 6.0 standard cubic feet per hour or less.
Pneumatic pumps driven by compressed natural gas: No state specific requirements.	✓ Pneumatic pumps: If there is an existing control device at the location of the pneumatic pump, reduce VOC emissions from each gas-driven chemical/methanol and	✓ Pneumatic pumps: require dry seals with no additional specific requirements	Pneumatic pumps driven by compressed natural gas: No state specific requirements.	✓ Control methane and VOC emissions associated with the discharge stream from natural gas operated pneumatic pumps by at least 95% by routing pump discharge streams into a closed loop system, vapor recovery unit or install zero bleed pumps.

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	diaphragm pump at the location by 95 percent or greater.			
Pigging Venting: No state specific requirements.	Pigging Venting: No specific requirements.	Pigging Venting: No specific requirements.	Pigging Venting: No state specific requirements.	✓ Require the operation of pig launchers without venting methane and hydrocarbons into the atmosphere.
✓ Wellbore Liquid Unloading: Exemption Criteria limits the VOC emissions to 2.7 tpy	Wellbore Liquid Unloading: No specific requirements. Soliciting public comments.	Operator must direct all pipeline—quality gas into a pipeline for sales. Any gas not captured and put into the sales pipeline may not be vented and must be flared in accordance with Performance Standard 10	✓ Wellbore Liquid Unloading: Requires best management practices to minimize hydrocarbon emissions and the need for well venting during well maintenance and liquids unloading.	✓ Wellbore Liquid Unloading: Require best management practices such as an automatic plunger lift system to minimize hydrocarbon and methane emissions during liquids unloading.
✓ Produced Water impoundments: Category No. 38 Exemption Criteria limits the VOC emissions to 2.7 tpy.	Produced Water Impoundments: No specific requirements.	For certification requires a closed loop system for impoundments (no ground pits) with leak detection with free hydrocarbons removed and total hydrocarbons substantially removed.	No specific requirements for Central impoundments.	✓ Produced Water impoundments: Address explicitly the emissions from impoundments tanks and explore the feasibility of add-on controls on enclosed storage tanks or a closed loop system for an efficient reuse of produced water.
Records must be maintained for five (5) years and made available to the DEP upon request.	Records must be maintained for five (5) years.	No specific requirement for the retention of records by the operator.	Records must be maintained for a period of two (2) years and made available to the Division upon request.	Records must be maintained for five (5) years and made available to the Department upon request.

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No compliance certification is required.	No compliance certification is required.	✓ Initial compliance certification with a full recertification audit every two years		✓ Annual Compliance certification must be submitted to the DEP by the responsible official.

Midstream Gas Compressor Stations				
Pennsylvania	EPA's Proposed NSPS	CSSD	Colorado	PA Draft GP-5 Recommendations
Air Quality General Plan Approval and/or General Operating Permit (BAQ-GPA/GP-5) 25 Pa. Code Chapter 127, Subchapter H	NSPS OOOOa, and Control Techniques Guidelines for VOC.	No Performance Standards for midstream gas compressor stations.	Colorado Regulation Nos. 3, 6, and 7.	✓ Expand GP-5 applicability to include Gas Transmission Stations or issue a new GP for the Gas Transmission sector.
✓ Leaks: Considers a "leak" as any release of gaseous hydrocarbons including methane that is determined by AVO inspection, a FLIR camera or any gas leak detection device approved by DEP.	Leaks: LDAR Program for well production facilities and natural gas compressor stations; leak threshold greater than 500 ppm of VOC.	No Performance Standards for midstream gas compressor stations.	Leaks: Compressor plants Constructed before May 1, 2014: > 2000 ppm VOC Compressor plants Constructed on or after May 1, 2014: > 500 ppm VOC Detected using EPA Method 21.	✓ Leaks: Considers a "leak" as any release of gaseous hydrocarbons including methane that is determined by AVO inspection, a FLIR camera or any gas leak detection device approved by DEP.
✓ LDAR: Monthly AVO inspections are required for entire site. Within 180 days of initial startup and quarterly	LDAR: Audio Visual Olfactory (AVO) inspections required only for tank covers and closed vent system on a monthly basis. After the initial inspection	No Performance Standards for midstream gas compressor stations.	Monthly AVO inspections are required. Inspection frequency depends on the quantity of fugitive VOC emissions . If VOC emissions are less than 12 tons per year, an annual	✓ Require monthly AVO inspections for entire site. Within 180 days of initial startup and quarterly thereafter , require a LDAR program using a FLIR camera or other DEP-approved device. GP-





Midstream Gas Compressor Stations

Pennsylvania	EPA's Proposed NSPS	CSSD	Colorado	PA Draft GP-5 Recommendations
<p>thereafter, LDAR is required using FLIR camera or other approved device. GP-5 applies only to sources with VOC emissions less than 50 tpy.</p>	<p>LDAR must be conducted using optical imaging camera semi-annually or annually. The frequency may be decreased to annual for sites that find leaks in less than 1% of the components. The frequency may be increased to quarterly for sites that find leaks more than 3% of the components.</p>		<p>inspection is required. LDAR is required monthly if VOC emissions are greater than 50 tons per year.</p>	<p>5 applies only to sources with VOC emissions less than 50 tpy.</p>
<p>Leaks are to be repaired as expeditiously as practicable, but no later than 15 calendar days after leak detections unless facility shutdowns or ordering of replacement parts are necessary for repair of the leaks.</p>	<p>Leaks are to be repaired as expeditiously as practicable, but no later than fifteen (15) calendar days after leak detections unless facility shutdowns or ordering of replacement parts are necessary for repair of the leaks.</p>	<p>No Performance Standards for midstream gas compressor stations.</p>	<p>Any detected leaks must be repaired within 5 to 15 days, unless a shutdown is required. Then the leaks must be repaired during the next scheduled shutdown.</p>	<p>✓ Require the repair of leaks as expeditiously as practicable, but no later than 15 calendar days after the detection of leaks unless facility shutdowns or ordering of replacement parts are necessary for repair of the leaks.</p> <p>The first attempt at repair must be conducted within 5 days of leak detection.</p>
<p>Replace reciprocating compressor rod packing every 26,000 hours or every 36 months.</p> <p>Reduce VOC emissions from each centrifugal</p>	<p>Replace reciprocating compressor rod packing every 26,000 hours or every 36 months or route emissions to a process under negative pressure (Reciprocating</p>	<p>No Performance Standards for midstream gas compressor stations.</p>	<p>Replace rod compressor rod packing every 26,000 hours or every 36 months.</p>	<p>✓ In addition, to existing rod packing requirements (every 26,000 hours or every 36 months) consider requiring owners/operators to prevent venting of methane and VOC</p>

Midstream Gas Compressor Stations

Pennsylvania	EPA's Proposed NSPS	CSSD	Colorado	PA Draft GP-5 Recommendations
compressor wet seal fluid gassing system by 95 percent.	compressors). Reduce VOC emissions from each centrifugal compressor wet seal fluid gassing system by 95 percent or greater.			emissions during all compressor maintenance and operational activities.
Storage Tanks Reduce VOC emissions by 95% with the potential to emit 6 tpy or greater. No detectable emissions consistent with the EPA Method 21 referenced in EPA's New Source Performance Standard (NSPS) for the Oil & Gas Sector (40 CFR Part 60, Subpart OOOO).	Storage Tanks: Reduce VOC emissions by 95% with the potential to emit 6 tpy or greater. No detectable emissions consistent with the EPA Method 21 referenced in EPA's New Source Performance Standard (NSPS) for the Oil & Gas Sector (40 CFR Part 60, Subpart OOOOa).	No Performance Standards for midstream gas compressor stations.	Storage Tanks: No detectable emissions consistent with the EPA Method 21 referenced in EPA's New Source Performance Standard (NSPS) for the Oil & Gas Sector (40 CFR Part 60, Subpart OOOO).	✓ Require the control of air contaminant emissions from storage tanks using control equipment with a 95% control efficiency.
Pigging Venting: No state specific requirements.	Pigging Venting: No specific requirements.	No Performance Standards for midstream gas compressor stations.	Pigging Venting: No state specific requirements.	✓ Require operation of pig launchers without venting methane and hydrocarbons into the outdoor atmosphere.
Pneumatic pumps driven by compressed natural gas: No state specific requirements.	✓ Pneumatic pumps: Zero natural gas emissions. If there is an existing control device at the location of the pneumatic pump, reduce VOC emissions from each gas-driven chemical/methanol and diaphragm pump at the	No Performance Standards for midstream gas compressor stations.	Pneumatic pumps driven by compressed natural gas: No state specific requirements.	✓ Control hydrocarbon emissions associated with the discharge stream from natural gas operated pneumatic pumps by at least 98% . Pump discharge streams would be routed into a closed loop system, vapor recovery unit (VRU) or replace with zero bleed pumps.

Midstream Gas Compressor Stations

Pennsylvania	EPA's Proposed NSPS	CSSD	Colorado	PA Draft GP-5 Recommendations
	location by 95 percent or greater.			
 Reporting: The owner or operator of the facility must submit to the DEP a compliance certification for GP-5 including LDAR requirements by March 1st of each year. In addition, by March 1st each year, Chapter 135 source reports for all air emissions for the preceding year, including methane emissions , from all natural gas operations including compressor stations, must be submitted for the annual emission inventory.	Reporting: The owner or operator of each facility subject to LDAR requirements must submit an annual report.	No Performance Standards for midstream gas compressor stations.	Reporting: The owner or operator of each facility subject to the LDAR requirements must submit a single annual report on or before May 31 of each year. Annual emission reporting does not include greenhouse gas emissions such as Methane.	 Reporting: The owner or operator of the facility must submit to the DEP a compliance certification for GP-5 including LDAR requirements by March 1st of each year. In addition, by March 1st each year, source reports for all air emissions for the preceding year, including methane emissions , must be submitted to DEP for natural gas operations including compressor stations. The report must also include LDAR inspection results for the year.
Pneumatic controllers: No state specific requirements.	Pneumatic controllers: Natural gas bleed rate no more than 6 scfh (Continuous bleed natural gas-driven pneumatic controllers greater than 6 scfh between wellhead and natural gas processing plant	No Performance Standards for midstream gas compressor stations.	 All new pneumatic controllers (placed in service after May 1, 2014) must emit an amount less than or equal to a low-bleed controller. No-bleed controllers must be used where on-site electrical grid power is accessible.	 Require no-bleed pneumatic controllers where electrical grid power is available or low bleed valves, if grid power is not accessible. All pneumatic controllers, other than no-bleed controllers, must be

Midstream Gas Compressor Stations

Pennsylvania	EPA's Proposed NSPS	CSSD	Colorado	PA Draft GP-5 Recommendations
	or oil pipeline).		<p>High-bleed controllers in service prior to May 1, 2014 must be replaced or retrofitted such that emissions are less than or equal to a low-bleed controller.</p> <p>All high-bleed controllers that must remain in service must obtain State approval.</p>	low bleed controllers with a leak rate of 6.0 standard cubic feet per hour or less.
<p>Glycol Dehydrators: Units with uncontrolled potential emission rate of VOC in excess of five (5) tons per year shall be controlled either by at least 95% with a condenser, a flare or other air cleaning device, or any alternative methods as approved by the Department.</p>	<p>Glycol Dehydrators: Units at an area source of HAP in Urban areas: Reduce HAP emissions by 95% (40 CFR 63.764) Units located at an area source of HAP outside of an Urban area: Minimize HAP emissions through work practice to maximize glycol circulation rate efficiency (40 CFR 63.764)</p>	No Performance Standards for midstream gas compressor stations.		<p>✓ Require at least 95% control for VOC emissions.</p>
<p>✓ Annual Compliance certification must be submitted by the responsible official.</p>	No compliance certification is required.	No Performance Standards for midstream gas compressor stations.		<p>✓ Annual Compliance certification must be submitted by the responsible official.</p>

Natural Gas Processing Plants

Pennsylvania	EPA's Proposed NSPS	CSSD	Colorado	PA Draft GP-5 Recommendations
Air Quality General Plan Approval and/or General Operating Permit (BAQ-GPA/GP-5). 25 Pa. Code Chapter 127, Subchapter H	NSPS Subpart OOOOa, and Control Techniques Guidelines for VOC.	No Performance Standards for gas processing	Colorado Regulation Nos. 3, 6, and 7.	Air Quality General Plan Approval and/or General Operating Permit (BAQ-GPA/GP-5). 25 Pa. Code Chapter 127, Subchapter H
Pneumatic controllers: No state specific requirements.	✓ Pneumatic controllers: Natural gas bleed rate zero scfh unless there are functional needs.	No Performance Standards for gas processing	✓ All new pneumatic controllers (placed in service after May 1, 2014) must emit an amount less than or equal to a low-bleed controller. No-bleed controllers must be used where on-site electrical grid power is accessible. High-bleed controllers in service prior to May 1, 2014 must be replaced or retrofitted such that emissions are less than or equal to a low-bleed controller. All high-bleed controllers that must remain in service require State approval.	✓ Natural gas bleed rate zero scfh unless there are functional needs.
Pigging Venting: No state specific requirements.	Pigging Venting: No specific requirements.	No Performance Standards for gas processing	Pigging Venting: No state specific requirements.	✓ Require operating pig launchers without venting methane and hydrocarbons into the outdoor atmosphere.
Pneumatic pumps driven by compressed natural	✓ Pneumatic pumps driven by compressed	No Performance Standards for gas processing	Pneumatic pumps driven by compressed natural gas: No	✓ Control hydrocarbon emissions associated with the

Natural Gas Processing Plants

Pennsylvania	EPA's Proposed NSPS	CSSD	Colorado	PA Draft GP-5 Recommendations
<p>gas: No state specific requirements.</p>	<p>natural gas: Zero natural gas emissions.</p>		<p>state-specific requirements.</p>	<p>discharge stream from natural gas operated pneumatic pumps by at least 98% by routing pump discharge streams into a closed loop system or vapor recovery unit (VRU); may replace with zero bleed pumps.</p>
<p> LDAR: Monthly AVO inspections are required for entire well site.</p> <p>Within 180 days of initial startup and quarterly thereafter, LDAR is required using FLIR camera or other approved device. GP-5 applies only to sources with VOC emissions less than 50 tpy.</p>	<p>LDAR: Audio Visual Olfactory (AVO) inspections required only for tank covers and closed vent system on a monthly basis.</p> <p>After the initial survey, LDAR must be conducted semi-annually or annually. The frequency may be decreased from semiannual to annual for sites with leaks in less than 1% of the components. Quarterly surveys for sites with leaks in more than 3% of the components.</p>	<p>No Performance Standards for gas processing</p>	<p>EPA's NSPS LDAR requirements.</p> <p>Reporting: The owner or operator of each facility subject to the LDAR requirements must submit a single annual report on or before May 31 of each year. Annual emission reporting does not include greenhouse gas emissions such as Methane.</p>	<p> In addition to EPA's NSPS LDAR requirements for natural gas processing facilities, the facilities must also comply with GP-5 requirements including monthly AVO inspections for the entire well site.</p> <p>Within 180 days of initial startup and quarterly thereafter, LDAR is required using a FLIR camera or other DEP-approved device.</p> <p>Reporting: Compliance certifications, including LDAR inspection results, must be submitted to DEP by March 1st each year. The source reports must account for all air emissions including methane for the preceding year.</p>