

## Managing Air Emissions from Oil and Gas Field Production

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**Managing Air Emissions from Oil and Gas Field Production:** *Natural gas is lauded as a cleaner-burning fuel than either coal or oil, but getting the fuel out of the ground can be a dirty process, especially given the widespread adoption of the technology known as hydraulic fracturing ("fracking"). Concerns about toxic air emissions from previously unregulated fracking sites led to the U.S. Environmental Protection Agency (EPA) announcement on 18 April 2012 of new and updated air pollution regulations for these facilities and certain other facilities of oil and natural gas production and transmission, [1]. In some cases, elevated concentrations of pollutants - some of them exceeding existing standards have been documented around oil and natural gas facilities in states such as Wyoming, Utah, Colorado, New Mexico, and Texas. Compliance with the new regulations is expected to result in major reductions in emissions of methane and volatile organic compounds (VOCs), particularly from new fracked natural gas wells.*

**Key words:** *Oil and Gas Production, US EPA Regulations, Well Green Completion, Fracking.*

### INTRODUCTION

The oil and natural gas exploration and production industry in the U.S. is highly dynamic and growing rapidly. Consequently, the number of wells in service and the potential for greater air emissions from oil and natural gas sources is also growing. It is anticipated that the number of gas and oil wells will continue to increase substantially in the future because of the continued and expanding use of horizontal drilling combined with hydraulic fracturing which allows for drilling in formerly inaccessible formations. Oil and gas production from unconventional formations such as shale deposits or plays has grown rapidly and is projected to steadily increase over the next two decades. Specifically, natural gas development is expected to increase by 44% from 2011 through 2040 and crude oil and natural gas liquids (NGL) are projected to increase by approximately 25% through 2019, [2]. Based on this increased oil and gas development, and the fact that half of new oil wells co-produce natural gas, the potential exists for increased air emissions from these operations.

### PRESENTING THE ISSUE

#### **V. Extraction in the United States**

Oil and natural gas drilling are getting easier in some ways, as success rates for finding reserves have increased from 75% in 1990 to 90% in 2009, [3]. But companies must drill deeper to extract the resources, with oil and gas drilling depths steadily increasing from averages of 4,841 feet in 1990 to almost 20,000 feet in 2013, [3]. Fracking enables drillers to liberate hard to reach oil and hydrocarbons from underground deposits.

A number of primary and secondary pollutants are linked with this web of facilities. One of them, methane, is over 20 times more potent a greenhouse gas than carbon dioxide (CO) when emitted directly to the atmosphere, [4]. Hydrogen sulfide and VOCs such as benzene, ethylbenzene, toluene, mixed xylenes, n-hexane, carbonyl sulfide, ethylene glycol, and 2,2,4 trimethylpentane are classified by the EPA as hazardous air pollutants, or air toxics, [5]. Sulfur dioxide, nitrogen oxides, carbon monoxide, fine particulate matter (PM), and ground level ozone are classified as criteria air pollutants, [6]. Both classifications of pollutants cause adverse human health effects, but whereas criteria air pollutants are regulated by air quality standards that localities must achieve, hazardous air pollutants are regulated by requiring specific control technologies for the targeted emissions.

In some cases, elevated concentrations of pollutants - some of them exceeding existing standards have been documented around oil and natural gas facilities in states such as Wyoming, Utah, Colorado, New Mexico, and Texas. In May 2012 the EPA designated a number of settings around the country as violating the 2008 ground level

ozone standard of 75 ppb (parts per billion) - these included Bakersfield CA; Jamestown NY; multi-county regions around Denver, Dallas, Fort Worth TX, Pittsburgh, Columbus, and Cleveland OH; and three counties in southwestern Wyoming.

Under the Clean Air Act, the EPA is required to review certain regulations every eight years and revise them if necessary. These regulations include New Source Performance Standards, or NSPSs (which apply to specific types of newly built, modified, and reconstructed facilities), and National Emission Standards for Hazardous Air Pollutants, or NESHAPs (which apply to the air toxics emitted from various facilities).

### VI. *New Era for Steady Growth in Natural Gas*

The primary tool for controlling the relevant emissions is equipment that captures and separates the mixed gases, liquids, and other substances that flow from new wells. Completing the well installation process with this kind of pollution control equipment has been labelled a “green completion.” Much of the captured material includes resources with substantial market value, including propane, butane, and liquefied natural gas. Green completions are mandatory for new wells beginning January 1st, 2015 and are encouraged on a voluntary basis before that. Larger companies tend to be the ones already using green completions. In some cases, companies have opted not to use green completions because the necessary transportation facilities (pipelines for the various gas constituents) are not in place. In other cases, low pressure in a well has made capture more difficult, or capture is less cost effective when VOC content is low. One company that has been using green completion equipment for more than half a dozen years is Devon Energy, headquartered in Oklahoma City. Devon Energy’s production facilities including wells, compressor stations, and gas plants currently total 1,222 in the state of Wyoming. Green completion reduces emissions and keeps gas in the pipeline, and the captured commodities are just as valuable as any commodity from any well, with no unusual impurities reducing their value.

Owners and operators that choose not to use green completions prior to January 2015 must burn off (or flare) the emissions coming from the new well. Flaring creates combustion pollutants such as carbon monoxide, nitrogen oxides (NOx), particulate matter (PM) , and CO , and contributes to formation of often uncharacterized secondary compounds. However, the EPA estimates that the benefits of preventing the escape of VOCs and methane far outweigh the damage caused by the pollutants produced by flaring, figure 1, [2].

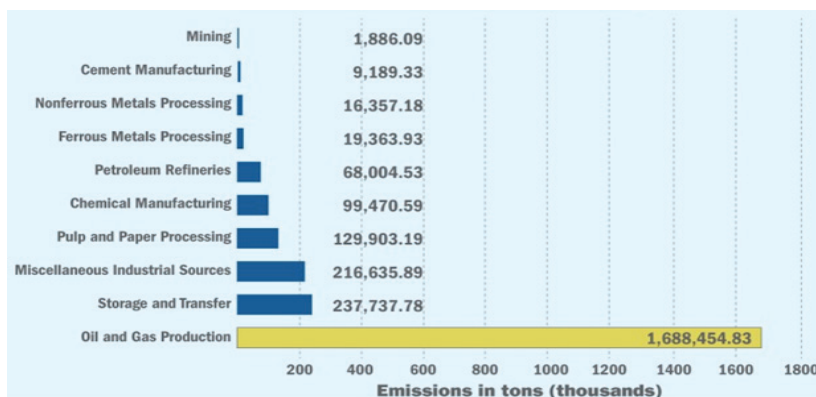


Figure 1. VOC emissions by industry, 2014 Emission Inventory

The EPA estimates the green completion process and other required changes will annually cut about 95% of the VOCs emitted from 11,400 newly fracked and 1,400 refracked wells. For 2015 the agency estimates that full implementation of the new rules

will result in reductions of 190,000 tons of VOCs, 11,000 tons of hazardous air pollutants, and methane equivalent to 18 million tons of CO above and beyond reductions already mandated in Wyoming, Colorado, and a few places in Texas, [7]. Finally, the new rules require reductions in emissions from equipment such as processing plants, storage tanks, pneumatic controllers, glycol dehydrators, and certain pipeline compressors, and they also add various reporting and notification requirements for the industry.

### ***VII. State-Level Actions***

As awareness of air pollution from natural gas extraction, processing, and transmission has risen, high production areas such as the city of Fort Worth and the states of Wyoming and Colorado have begun requiring processes similar to green completions. Wyoming has also been monitoring some pollution hot spots, requiring some industry reporting of emissions, and revising its regulations. By end of 2015, WY Department of Environmental Quality's Air Quality Division (WY DEQ AQD) will enforce rules nearly identical to those of the EPA, or more stringent for some areas around the state.

However, that alone won't be enough to bring Wyoming counties currently violating the ground level ozone standard into compliance. That job might have been easier if the new EPA rules had addressed existing wells and facilities. That exclusion makes it more difficult to reduce more emissions, because Wyoming, like the EPA, is limited in its authority to rein in existing pollution sources. In the absence of EPA regulations, the department will implement strategies that have helped in the past, such as incorporating requirements for diesel powered equipment into permitting processes. The EPA explicitly chose to not have the new rules apply to existing wells because, on a per well basis, new wells produce far more VOC emissions and can offset costs for implementing the new rules with sales of captured products. The fact that most existing oil and natural gas wells tend to have relatively low or unknown VOC emissions lessens the potential for applying the new rules to them in a cost effective manner, even though, combined, they remain a major source of emissions of VOCs and many other pollutants.

### ***VIII. Reducing Drill Rig Emissions in Wyoming***

Operational practices indicate the majority of the well completions in the Jonah/Pinedale area are being done with a four phase separation flareless completion system and others are utilizing sand trap technology reducing flaring by 50%. The operators in the Anticline indicated more resistance toward using the flareless completion system. While the points made concerning safety, financial and operational risks are valid, the issues are not insurmountable as demonstrated by the companies currently practicing "Green Completions". Based on review of the information and current practice by a number of operators, the Division considers the "Green Completion" or flareless completion as representing "Best Available Control Technology" (BACT) for well completions in the area and in the entire state.

WY DEQ AQD has one of the best in nation Oil @ Gas permitting program, which sets example for implementing various control equipment to reduce emissions from well sites and drill rigs. The E-POD is the most recent emissions control technology introduced by CleanAIR, a manufacturer of catalyzed diesel particulate filters (DPFs), oxidation catalysts and selective catalytic reduction (SCR) technology. The new E-POD system combines CleanAIR's closed loop controller technology, product fabrication and emissions technologies to reduce four toxic pollutants: NOx, PM, CO and hydro carbons (HC). The second and largest installation to date of the new E-POD system has recently been completed on seven Caterpillar 3512 diesel generator set units operating on drill rigs in Wyoming's Pinedale Anticline Project Area (PAPA), Figure 2. The design of the E-POD combines nontoxic, zeolite based SCR catalyst, diesel particulate filters or diesel oxidation converters and a reductant mixing system into a single insulated, stainless steel, critical grade (or supercritical) sound attenuation silencer package. Specifically, the E-POD offers a range of operation from 518 to 1002 degrees Fahrenheit exhaust temperatures (270 to

540 Celsius). The E-POD also features CleanAIR's "all-in-one" dosing cabinet, which combines an electronic control system and injection system into one unit. Using automatic data logging, programmable set Points and basic internal diagnostics, the dosing cabinet is designed to offer uncomplicated operational control and monitoring of the E-POD system.



Figure 2. Three E-PODs installed on generators in Wyoming oil and gas fields

Other potential Air Quality Control Strategies to Reduce Emissions from fast growing oil and gas industry specifically in the Upper Green River Basin include:

1. VOC Reduction by: Significantly increasing compliance inspection presence and effort on follow up; Require a leak detection and repair program (LDAR) to increase industry self-inspection and response; Shut-down sites that are operating out of compliance; Require offsets for new permits, which would target emissions from existing sources (such as open top water tanks); Revise current Oil & Gas Best Achievable Control Technology Guidance to further reduce emissions; Add requirement to control water tank vapors; Require flaring of all planned maintenance blowdowns, including pipeline companies; Route pneumatic pump emissions to the fuel gas system or a combustor.

2. NO<sub>x</sub> Reduction by: Conduct limited modeling in-house to examine the effect of drill rigs being clustered in the southern part of the Anticline during winter months, and develop a strategy for further evaluation of the impact of rig placement; Require emissions testing on all rigs in Sublette County to determine actual emission rates; Reduce truck idling; Electrification of compression; Require catalysts on all rig's diesel engines, or replacing with natural gas burning engines if pipe-line gas is available at the site; Liquids gathering; Add burner maintenance to list of required maintenance; Determine the cost and feasibility of controls on diesel soot.

## CONCLUSION

Since 2007, the Air Quality Division has in place a permitting program implementing "Best Available Control Technology" (BACT) for well completion activities conducted by all Jonah/Pinedale area gas producers. The intent is to require, through permitting, reduction of air emissions associated with well completion activities. The permitting process has been selected as the vehicle to implement BACT for well completion activities with each operator obtaining a single permit addressing all well completion activities in the area. The process allows for implementation of BACT through permit conditions, for comment through the public notice procedures and for revision if the initial permit conditions prove to be unworkable. Any revisions to conditions would be noticed and would allow for public comments as well.

Proposed Permit Conditions – for each well completion include: A minimum of 90% of the fluids flowing from a well during completion operations will be routed through

separation equipment for recovery of gas and condensate rather than routing these fluids to a flare or venting them to atmosphere; The opacity of visible emissions during flaring of completion fluids will be limited to 20%; Records will be maintained summarizing all fluid and gas volumes routed through separation equipment or routed to a flare or pit throughout each completion operation and will be submitted to the Division in order to demonstrate compliance with permit requirements; VOC, HAP, NO<sub>x</sub> and CO emissions associated with flaring and venting episodes during well completion operations will be calculated; The Division will be notified of each well completion 10 days prior to initiation of completion activities; Each permit may contain conditions specific to each operator's completion practices that allow limited flaring or venting provided such practices are justified in the permit application and the Division finds such practices to represent BACT during the review and permitting process. Conditions allowing such limited flaring or venting will also include notification requirements.

**Disclaimer:** This article represents my personal view based on my work experience and job obligations and does not speak for WY DEQ AQD as agency.

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**The paper has been reviewed.  
Докладът е рецензиран.**