BEFORE THE ENVIRONMENTAL IMPROVEMENT BOARD

IN THE MATTER OF THE PETITION TO ADOPT NEW REGULATIONS WITHIN 20.2 NMAC, STATEWIDE AIR QUALITY REGULATIONS, TO REQUIRE GREENHOUSE GAS EMISSIONS REDUCTIONS NEW ENERGY ECONOMY, INC. PETITIONER	)))))))	EIB No. 8-19 (R)

REBUTTAL TESTIMONY OF DAN RANDOLPH

My name is Daniel (Dan) Randolph and I will be rebutting the testimony of Bruce A. Gantner and Darren Smith regarding the availability of technologies to reduce methane and carbon dioxide emissions produced by the oil and gas industry. My education and experience are described in Rebuttal Exhibit R47.

The primary purpose of my rebuttal testimony is to address specific statements made by Gantner and Smith. As I will discuss, their testimonies contain many examples of impediments to the use of various emissions reduction technologies. And while many of these are undoubtedly real, I will attempt to provide examples that demonstrate that some of the impediments can be overcome, or that the impediments are not as wide-reaching as suggested by Gantner and Smith.

The other point I'd like to make up front is that this rule would not require the use of the emissions reductions technologies discussed by Gantner and Smith, because it only requires that facilities emitting more than 25,000 metric tons per year of CO_2e are subject to the emissions cap. The vast majority of the technologies discussed by Gantner and Smith, and discussed below, if adopted by the industry when feasible, have the potential to generate offsets for oil and gas producers.

GREEN COMPLETIONS

1. Innovative technology and approaches enable the use of green completions under more circumstances that indicated by industry testimony

A great deal of testimony was provided by Bruce Gantner and Darren Smith providing reasons why green completions are not possible in all circumstances.

Low pressure reservoirs

Darren Smith, in his testimony, states that, "wells with insufficient bottomhole pressure will not be able to flowback into the gathering system and when this is the case, such as in mature fields, <u>a well cannot be green completed</u>." Prepared Direct Testimony of Darren Smith, p.12, lines 20-22.

But testimony from Bruce Gantner appears to contradict Smith's statement. Gantner states that, "Where formation pressures are insufficient to overcome line pressure, compression is employed to boost the gas pressure." Prepared Direct Testimony of Bruce Gantner at page 10, lines 6,7.

Smith's own company, Devon, in a presentation at an EPA Natural Gas STAR workshop, included information on how it is possible to use green completions on low pressure wells by using portable compressors to start-up the well when reservoir pressure is low. According to that presentation, the compressors create artificial lift to clear fluids and boost gas to the sales line. Rebuttal Exhibit R48, Slide 8.

I'm not arguing that green completions are always possible when reservoir pressure is low, but rather, that what seems to be impossible to one company is often shown to be possible through another company's innovation. A prime example of this is the ability of BP to perform green completions in coalbed methane formations in the San Juan Basin of Colorado.

In 2007, OGAP participated in the Four Corners Air Quality Task Force, which included industry, government, and members of the public. During this process comments were made about how “With the depleted status of the conventional San Juan basin reservoirs and the characteristics of coal bed methane reservoirs, **this is not an available option for the SJ basin area.**” Furthermore, we were told that green completion technology may not be suited to handle different completion techniques used in coalbed methane formations, for example the use of compressed air to clean out wells. The problem with compressed air is that the oxygen in the air “ mixed with natural gas cannot be shipped to a pipeline due to the high potential for spontaneous combustion under typical pipeline temperatures and pressures.” Rebuttal Exhibit R49.

Despite what others viewed as impossible conditions, BP developed a way to perform green completions in coalbed methane reservoirs in the Colorado portion of the San Juan Basin. The technique that they used enabled them to overcome the explosion hazard by using methane instead of air to clean out the well. Exhibit R50.

BP was even able to perform its green completions in what they termed a “low energy reservoir.” What BP did was create an underbalanced situation where the pressure in the wellbore was less than the pressure in the low energy reservoir. By reducing pressure within the well, the hydraulic fracturing fluids and gas from the formation were able to flow into the well and be cleaned out, clearing the way for methane to flow to the well. During the green completion cleanout process the gas was captured and sent into a pipeline, rather than being vented. Exhibit R51.

The purpose of mentioning this example is not to say that this particular approach will work in all cases where bottomhole or reservoir pressure is low. I’m not qualified to answer that. What it does demonstrate is that innovation happens. BP did what others said could not be done.

Third-party gathering lines

Both Gantner and Smith cite logistical constraints, such as third party ownership of gathering lines, as a primary impediment to utilization of this technology. As Gantner points out, “gatherers in the San Juan Basin will not accept gas for sale until the nitrogen content has reached a suitable level and no oxygen is present.” [Gantner testimony, pp. 9, 10]

Smith’s characterization of the situation was stronger. He said that “In order for an Operator to be able to perform green completions on wells they would have to rely on third party gathering company to make and adjustment to their right of way and permitting work to track an Operator’s constantly changing drilling schedule, take on capital risk that the well will be commercial before it is tested, and predict the correct line size before a well is tested or the development in an area is known. It is these risks and uncertainties that make third party green completions impractical.” [Smith testimony, p. 12]

In May of this year ConocoPhillips gave a presentation at the EPA Natural Gas STAR Producers Technology Transfer Workshop in Farmington. The presentation described a “Gas Recovery Cleanout System,” which is a type of green completion that ConocoPhillips started using in the San Juan Basin of New Mexico in 2007. Like BP in La Plata County, Colorado, ConocoPhillips’ system primarily used methane rather than gases like oxygen or nitrogen to clean out their wells. [Exhibit R52, Slide 5]

ConocoPhillilps was able to successfully utilize its green completion technology in a variety of formations including Fruitland Coal, Dakota sandstone and Mesa Verde sandstone. And the were able to overcome some of the problems raised by Bruce Gantner in his testimony, namely meeting third party gatherers’ standards for oxygen and nitrogen content. The presentation shows that ConocoPhillips was able to meet the low (10 ppm) oxygen requirements of the third party pipeline operator, [Exhibit R52, Slide 9] and they developed a process to get nitrogen down to pipeline specifications. [Exhibit R52, Slide 10]

The ConocoPhillips presentation also indicates that they were able to work with third party gatherers and overcome the impracticalities of tying into their systems. [Exhibit R52, Slide

9] Part of ConocoPhillips' strategy for working with third party gatherers, which they shared in their presentation, was "to continue letting the pipeline companies know when we are using a gas recovery cleanout many wells in advance." [Exhibit R52, Slide 12]

Thus, ConocoPhillips has shown that it is possible, even profitable, to work around the various obstacles to green completions outlined in Gantner's and Smith's testimonies.

Like BP, ConocoPhillips has demonstrated what others said could not be done. They successfully performed green completions in the San Juan Basin, and they showed that while third party green completions may seem impractical, they are possible. Again, we are not wanting to imply that this, or any other single technology, will be feasible in all situations, but rather that meaningful GHG reductions can be achieved, even in seemingly difficult circumstances.

2. Green completions are being successful at reducing CO2e emissions in the San Juan Basin

While green completions may not be feasible in all situations, it is clear that green completions can and are being successfully conducted in the San Juan Basin.

BP's experience

For years, BP has been using green completions in coalbed methane formations in La Plata County, which is just over the Colorado border but still in the San Juan Basin. In 2004 BP's green completions in the Colorado portion of the San Juan Basin had prevented the release of 7.8 million cubic feet of natural gas (or approximately 3,155 metric tons of CO2e). [Exhibit R53, pp. 7, 8 By 2007, BP's green completions in the San Juan Basin were preventing the emission of approximately 6,850 tons of CO2e per year. In 2007, BP reportedly drilled 46 wells in the San Juan Basin, using green completions on about 40% of those wells. [Exhibit R50] In other words, 18 wells received green completions, so each green completion operation prevented approximately 380 tons of CO2e from entering the atmosphere.

The Durango Herald quotes Phil Loftin of BP, as saying that the company roughly breaks even on its green completions in the San Juan Basin. [Exhibit R50] This was corroborated by BP's 2008 presentation where the company indicated that while the cost of their green completion unit is approximately 30% more than a conventional air cleanout unit, the value of gas recovered and sold from the green completion process is roughly equal to the additional cost.[Exhibit R51, Slides 4 and 5] A Casper Tribune article reports that BP's first green completion unit, which was tested in New Mexico, cost $1.4 million, and within 2 years that investment had reaped more than $1.6 million for BP (gas and condensate recovered from the green completion operations). [Exhibit R54]

ConocoPhillips' experience

In ConocoPhillips' 2008 (3rd Quarter) Spirit Magazine, the company had a full-page picture with text describing a green completion pilot project in the San Juan Basin near Farmington, NM. [Exhibit R55, p. labeled 4, p 6 of PDF] In a February, 2008 letter to NMED, Bruce Gantner provided additional information on the company's green completion program.

> *"ConocoPhillips is just in the beginning phases of evaluating the potential of this technology in our completions and has so far found the volumes of gas significant enough in some circumstances to warrant evaluating Green Completions technology. Although we have only recovered gas from four wells to date, the net gas recovered was approximately 11,900 mcf of gas and the methane equivalent reduction from these two wells would be 177 metric tons. Successful application of this technology to our future well count could result in significant emissions reductions."* [Exhibit R56, p. labeled 8, p. 10 of PDF]

By 2010, the company had applied the green completion technology to more than 100 wells. The ConocoPhillips 2010 Gas Star presentation provides data showing that by using green completions on its Fruitland Coalbed Methane wells (Colorado San Juan Basin) the company was able to reduce emissions of methane, and increase sales, by approximately 2 MMcf/well (809 metric tons of CO_2e). In the Dakota sandstone standalone completions, these savings were approximately 6 MMcf/well (2,427 metric tons of CO_2e), while in the commingled Mesa Verde - Dakota wells, the savings were the greatest at approximately 14.5 MMcf/well (2,427 metric tons of CO_2e). The cost of the green completion equipment was reported to be $4,000 per day. [Exhibit R52, Slides 8, 9,10]

The company did not provide a breakdown of how many Fruitland, Dakota and Mesa Verde-Dakota wells were drilled, so it's not possible to determine the total tons of CO_2e that were avoided by ConocoPhillips by using green completions on 100 wells. At minimum, if all were Fruitland wells, 80,900 tons of CO_2e emissions would have been prevented, and at maximum, if all were Mesa Verde-Dakota commingled wells, 242,700 metric tons would have been avoided. The reality is somewhere in between.

This is a significant amount of CO_2e that did not enter the atmosphere. If we take a number in the middle of the two estimates, for example 100,000 tons of CO_2e - these avoided emissions would be enough offset emissions for two of ConocoPhillips' gas plants (East Vaccuum Liquid Recovery and Wingate Fractionation Plants, which had 65.4 and 36.8 mt of CO_2 in 2008. [Testimony of Michael Schneider, p. 5].

Devon's experience

In Darren Smith's testimony he said that Devon has performed "reduced emissions completions" or green completions in New Mexico. But no data were provided regarding the number of green completions performed by Devon in New Mexico, where in the state these green completions have been performed, what level of emissions savings have been achieved through green completions in the state, nor the costs of these operations. [Smith testimony, p. 5]

At a 2010 EPA Gas Star Producers Technology Transfer Workshop Devon outlined a green completion technology called Sand Buster, which was being used in the San Juan Basin. Sand Buster is a technology created by Devon employee Robert Jordan. Devon reported results from two wells. In one case, gas flowed through the Sand Buster for 20 days, at rates ranging from 300 to 2,250 million cubic feet (mmcf) per day, resulting in increased revenue of $196,000. In a second example, gas flowed through sand buster for 8 days, at rates ranging from 1,900 to 3,300 mmcf per day, with $132,000 increased revenue. Both of these examples came from wells completed in 2006. [Exhibit R57 - slides 26, 27, 28, 29, 30]

These numbers indicate extremely high amounts of captured gas - recall that the gas captured by ConocoPhillips wells in the San Juan Basin was in the range of 2 - 14.5 mmcf per well completion (not per day). Exhibit R52 - Slides 9, 10] And the revenues reported for Devon's San Juan Basin Sand Buster wells are double or quadruple the amounts that Devon was seeing from green completions on its Barnett Shale wells (i.e., they report approximately $50,000 revenue from additional gas sales from Barnett Shale reduced emission completions). [Exhibit R57 - slide 25] If these Sand Buster numbers are reflective of the gas capture that might be achievable at other San Juan wells, then there appears to be tremendous potential for greenhouse gas emissions reductions by using the Sand Buster green completion technology.

Other experience

Finally, as Bruce Gantner pointed out in his testimony, there is at least one other operator in the San Juan Basin performing green completions. This unnamed operator has been increasing its use of green completions. in 2009, 30% of its new wells were drilled using green completion equipment, and in 2010 it plans to use the technology on 75% of its new wells. Furthermore, according to Gantner, this one operator "has the entire capacity of commercially available equipment to perform closed-loop completions at present. . . the utilization of closed-loop completions is at its upper limit until more equipment is brought into the San Juan Basin." [Gantner Testimony, p. 10, lines 4-12]

To recap this portion of my testimony, companies are utilizing green completion technologies in the San Juan Basin of New Mexico with impressive reductions in greenhouse gas emissions and in some cases increased revenues to the companies performing green completions. It appears that growth in use of the technology is currently only limited by the availability of green completion equipment, a limit that industry can clearly surmount. It is precisely efforts like these that a) show the technology is present and works, and b) creates great entrepreneurial opportunities for suppliers and innovators.

HEATERS AND BOILERS

Testimony from Bruce Gantner and Darren Smith included many excellent examples of emissions reduction technologies. But lacking in their testimony were hard numbers or examples of what levels of emissions reductions we might expect from the various control technologies.

For example, in the category of heaters and boilers Bruce Gantner stated that "The main technology being utilized within the upstream portion of the San Juan Basin is the insulation of tanks and vessels to reduce heat losses to the environment, particularly during cold weather. Insulation of new tanks and vessels prior to setting them at field locations has been shown to be highly economic." [Gantner testimony, p. 16]

What was missing was any indication of the amount of greenhouse gas emissions that could be reduced by insulating tanks and separators. We were able to pull together some information on potential emissions reductions in this area. We, of course, do not have any first-hand data, so we collected industry examples from publicly available presentations.

ConocoPhillips tank and separator insulation

In September, 2007, the EPA Natural Gas STAR program held a Technology Transfer Workshop in Durango, Colorado. At this workshop Bruce Gantner from ConocoPhillips did a presentation on "ConocoPhillips Experience in Methane Emission Mitigation."

In one example, Mr. Gantner provided information on emissions reductions that were achieved by insulating tanks and separators. In a pilot project, the company insulated equipment on five well sites in the San Juan Basin of New Mexico. [Exhibit R58 - Slide 7] Gantner summarized the results of the pilot project as follows:

Typical Well Site Emission Reductions

Assuming insulation of one separator and one 286 bbl tank.

Total fuel saved: 3.14 MMbtu/day or 471 MMBtu/year

CO_2 Reduction = 471 MMBtu/year x 120 lbs of CO_2/MMBtu = 56,520 lbs CO_2/year or 28.27 tpy per well site.

And according to Gantner, "Assuming like-kind reductions across ConocoPhillips wellsites": 10,000 wellsites x 28.26 tpy = 282,600 tpy CO_2 reductions. [exhibit R58 – Slide 18]

As mentioned previously, in Bruce Gantner's testimony for this hearing he stated that insulation of new tanks and vessels prior to setting them at field locations has been shown to be highly economic, while "insulation of existing field tanks and vessels by performing retrofit insulation in the field has proven to be less economic and the longevity of this insulation is not as good as for new equipment." [Gantner testimony, p. 16] But Gantner did not provide any actual cost figures. In 2007, which is when Gantner gave his Durango Gas Star presentation, ConocoPhillips had insulated tanks and separators at just five of its well sites. We haven't been able to find any more recent data on ConocoPhillips' tank insulation progress. But it is likely that there remains a large opportunity for CO_2 reductions using this "highly economic" technology on new wells. Additionally, while less economic there are still major CO_2 reductions to be had by insulating close to 10,000 of ConocoPhillips' existing well sites. Presumably, other operators in the San Juan Basin would also be able to realize similar CO_2 reductions by insulating their tanks and separators.

It is unlikely that ConocoPhillips would need to or be able to insulate tanks and separators all 10,000 of its well sites. But if even half of those sites were insulated, the company could reduce CO_2 emissions by 140,000 tons per year. That would go a long way toward offsetting the CO_2 emissions from its three gas processing facilities, which together, according to Michael Schneider's testimony, emitted 346,000 tons of CO_2 in 2008. [Schneider Testimony, p.5]

VAPOR RECOVERY UNITS (VRU)

Vapor recovery units (VRU) capture hydrocarbon vapors that would otherwise be vented from oil, condensate and produced water storage tanks. Darren Smith listed a number of limitations on the use of VRUs in New Mexico. [Darren Smith Testimony, p. 13,14]

These are summarized below:

1) VRUs operate with electric motors, which either generate GHG emissions directly,or transfer GHG emissions from the wellsite to an Electric Generation Unit.

2) VRUs needed a minimum volume of vapor to operate, and that volume is approximately 10 mscf/day. . . NMDE's Air Quality Bureau already requires that high

vapor emitting facilities install control devices. What would be affected by this NEE proposal would be the small, low vapor facilities where a VRU won't work.

3) VRUs cannot generate enough compression to overcome system pressures above approx. 300 psig.

4) VRUs are notorious for injecting oxygen into pipeline systems, which is not permissible because it accelerates pipe corrosion. . . elaborate blanket gas systems that add natural gas to tanks as they are unloaded to prevent the development of vaccuum pressure are needed to control oxygen entry. Operation of these systems increases fugitive emissions of natural gas.

There are two areas where we felt the need to provide some input. In response to Darren Smith's comment that VRUs won't work on small, low vapor facilities, we have found an example of a VRU technology that can operate below 10 mscf/day. And in response to Smith's testimony that VRUs are notorious for injecting oxygen into pipeline systems, we have found an example of a VRU technology that can prevent oxygen from entering the pipeline, thus eliminating the explosion and corrosion hazards.

Low vapor VRU option

The Vapor Jet system is an alternative to conventional vapor recovery technology. It was designed to recover low volumes of hydrocarbon vapors from oil production storage tanks and produced water tanks. According to an 1993 article published by the Society of Petroleum Engineers, and written by W.G. Webb of Conoco Inc., the system is ideally suited for facilities with hydrocarbon vapor volumes too small to economically justify conventional vapor recovery systems. And the technology is most cost effective when vapor volumes are less than 10 mcf per day. [Exhibit R59, p. labeled 111, p 1 of PDF]

The Vapor Jet technology is included in EPA Gas Star's Recommended Technologies and Practices, under the heading "Installing Vapor Recovery Units on Crude Oil Storage Tanks." [Exhibit R60 - slides 5, 29, 30]

The Vapor Jet system uses a pressurized stream of produced water to operate a jet pump, so a nearby source of produced water is required. Also, as with conventional VRUs, the vapor pump requires an electric motor to power the pump. [Exhibit R59 - p. labeled 112, p 2 of PDF]

We did not find any examples of the Vapor Jet being used in New Mexico. But an article published in 2000 reported successes using the Vapor Jet system at a couple of sites in West Texas. In one example, over a five-year period (1994 - 1999) Devon captured and sold 55 million cubic feet of hydrocarbon tank vapors from a tank battery installation. At the end of this period, the equipment was deemed "so durable that another 10-15 years of life is expected." Over the five year period the only maintenance required was an occasional pump packing, and the only operating cost was the cost of electricity to drive the centrifugal pumps - a cost less than $0.40/mcf of captured gas. [Exhibit R61, pp. labeled 12 - 14, pp 2-4 of PDF]

So there may be opportunities to reduce emissions in New Mexico using the Vapor Jet system even when the emissions are below 10 mcf. We only found examples of this technology being used at oil producing sites, so it is possible that from an economic standpoint the greatest opportunities for using the Vapor Jet system will be in the oil producing areas in southeast New Mexico.

The Scroll Compressor

As described by Gantner, conventional VRUs are essentially a vacuum system designed to pull flashed vapors into a system that condenses some vapors into liquids and routes the remaining gases either to a flare for combustion or to a compressor for injection into a gas sales line. [Gantner testimony, p. 18] The Scroll compressor was designed to help overcome the problem of oxygen entering the VRU system and creating an explosive hazard when the vapors/gas are injected into the gas sales line. Darren Smith mentioned one technique used to deal with the oxygen issues, i.e., using a blanket gas such as N2 to take up the space and prevent oxygen inflow. This technique, he said, can lead to excess fugitive emissions. [Smith testimony, p.14]

There is, however, another option for preventing oxygen entry. In 2008, Devon made a presentation on Scroll Compressors at the annual EPA Natural Gas STAR Implementation Workshop. As indicated in Smith's testimony, Devon had been experiencing problems with conventional VRUs such as oxygen entry into pipelines, increased emissions and loss of valuable vapors, and other issues related to conventional VRU design. [Exhibit R62- slide 4] So Devon conducted a pilot project using the Copeland Scroll VRU technology developed by Emerson. The Scroll has a hermetically sealed design, which, according to the Devon Presentation, eliminates oxygen, oil and gas leak paths. Devon also found many other benefits to the Scroll unit such as low cost maintenance requirements, low noise levels, its a mobile unit, and the unit can be optimized to match compressor horsepower with fluctuating flow rates and pressures. [Exhibit R62 - slide 22] In Devon's pilot project, they had a daily recovery rate of 70 mcf of gas with a btu of 2,000 (i.e., they captured heavier hydrocarbons than simply methane), and annually, they reported that the sale of this gas would reap $403,200. [Exhibit R62 - slide 24]

Scroll compressors were first used in 2004, and there are now more than 70 of them installed with VRUs across the US. [Exhibit R63- slide 17] We were not able to find any examples of the Scroll compressor being used with VRUs in New Mexico.

We've provided these examples to show that while there are certainly limitations to some of the emissions reductions technologies, industry is constantly innovating to address these challenges. And while not universally applicable, these examples show that at least in some cases, limitations of VRUs outlined by Darren Smith can be overcome, and emissions reductions can be significant and cost-effective.

TECHNOLOGY: INNOVATION, ADOPTION AND CHANGING ECONOMICS

There are many factors which influence technological innovation and the adoption of new technologies. Within an industry as competitive as the natural gas industry, the successful adaptation to changes in economics, technology, and regulation, are all critical components of the pathway for successful companies. These are all evident in both Gantner's and Smith's testimony. One of the primary ways in which public health, safety and environmental regulations function is through their influence on the development and adoption of new technologies.

We do not pretend to know precisely how the NEE proposal will affect the natural gas industry of New Mexico. However, New Mexico has large proven gas reserves with extensive infrastructure and personnel resources built over many decades. The NEE proposal will allow New Mexico's industry to adapt to a carbon emission reducing economy, ultimately allowing it to gain competitive advantage. Through the innovation demonstrated by companies such as Devon and ConocoPhillips, and the adoption of technologies aimed at meeting new geologic, technical, or regulatory hurdles, New Mexico's oil and gas industry will continue to thrive regardless of the passage of NEE's proposal.

This concludes my rebuttal testimony, and I have included an Index of my Rebuttal Exhibits R47 through R63 on the next page.

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