

AIR QUALITY ISSUES RELATED TO COAL BED METHANE DEVELOPMENT IN THE POWDER RIVER BASIN

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ABSTRACT

The Powder River Basin, located partially in Wyoming, has become the site of widespread development of coal bed methane (CBM) as an energy source. The rapid attraction of production companies to this area of Wyoming has brought with it a phenomenal growth in the number of air emission sources that poses certain dilemmas for the environment at large, as well as energy industries and the regulatory agencies. The large influx of combustion sources, such as compressor engines and electric generators, raises issues concerning the consumption of the Nitrogen Oxides increment, formaldehyde emissions from lean burn combustion sources, diesel and unpaved road particulate matter emissions and impacts on visibility. In addition, the growth in developing the CBM resource presents myriad concerns for permitting and regulating these sources of air pollution.

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Introduction

The Powder River Basin, located in Wyoming and Montana, has become the site of widespread development of coal bed methane (CBM) as an energy source in the very recent past. The rapid attraction of natural gas production companies to this area of the nation has brought with it a phenomenal growth in the number of air emission sources that poses certain dilemmas for the environment at large, as well as energy industries and the regulatory agencies. The large influx of combustion sources, such as compressor engines and electric generators, raises issues concerning the consumption of the Nitrogen Oxides increment, formaldehyde emissions from lean burn combustion sources, diesel particulate matter emissions and impacts on visibility. To date, in excess of 16,000 CBM wells have been permitted to drill and more than 3,500 wells are on federal lands.¹ By the time this paper is presented, the number will have grown. This phenomenal growth in developing the CBM resource presents myriad concerns for permitting and regulating these sources of air pollution.²

Background

The Powder River Basin is a topographically interesting portion of the Rocky Mountain West. The Powder River itself is one of two major tributaries to the Yellowstone River. The river originates in east-central Wyoming and flows north to Montana. It is fed from the west by the perennial streams of the Bighorn range and from the east by ephemeral streams. The Basin is essentially bounded on the West by the Bighorn mountain range, with beautiful vistas of Cloud Peak and Gardner Mountain, and on the East by the Black Hills. For some, it epitomizes the essence of all that is "western".³

The wildlife of the Basin is varied and numerous in species. It is one of the last remaining habitats of the plains elk where bald eagle, falcon, grouse and red-tailed hawk fly overhead. The area is also home to pronghorn antelope, mule and whitetail deer, fox, bear, turkey, mountain lions and the North American lynx. Fishing in several places of the region is considered among the best in the United States.

From a cultural resource perspective, the Native Americans who once freely roamed this portion of the Great Plains consider the area "sacred". It was here that Chief Crazy Horse, a distinguished Oglala Sioux, took his stand to prevent American encroachment of Lakota lands. It is this area of which he said, "My lands are where my dead lie buried".

Geologically, it is also known for what is buried beneath the soil. The Powder River Basin overlays coal beds over sixty meters thick that were deposited during the Paleocene era, 65-55 million years ago. Pursuit of coal and its energy byproducts within the Basin has followed closely on the heels of energy development in the San Juan Basin,

where coal bed methane became the focus of natural gas production efforts several years earlier. Coal deposits in the area are known for their high quality and low sulfur and ash, which are preferred characteristics for coal-fired power generation systems in the West.

Depending on the source of information, natural gas reserves in the Basin are estimated to be twenty-four to thirty-two trillion cubic feet.⁴ One industry estimate of the recoverable gas reserves is six to nine trillion cubic feet.⁵ The United States Geologic Survey estimate is one hundred trillion cubic feet. With newly developed extraction technologies, the natural gas industry has come to regard the Powder River Basin as a major resource of coal bed methane gas.⁶

It is this history, culture and geology that make the development of coal bed methane in the Powder River Basin a controversial issue, and which causes air quality to be an issue for industry, regulators and the community at large.

Air Quality Issues Related to Coal Bed Methane Development

In general, the air quality in the Powder River Basin has been very good. There have been occasional, elevated levels of total suspended particulate (TSP) and Sulfur Dioxide (SO₂) due to oil and gas production, coal mining and industrial and refining activities, but there have been no significant non-attainment issues to date.

Until relatively recently, the growth in air pollution sources has been relatively slow. It has only been since the early 1990's that energy development in the Basin has spiked the installation of new air pollution sources, especially in the Wyoming portion of the basin. During the most recent past there have been marked increases in the placement and operation of wellhead equipment, compression equipment, dehydrators, tanks, power generation units, and the myriad auxiliary equipment associated with oil and gas development. And wherever gas resources are found there is usually an increase in the installation of energy delivery infrastructures. This infrastructure development in the Basin includes the installation of natural gas transmission pipelines, construction of electric transmission facilities choosing to take advantage of nearby energy resources, and a substantial number of new, unpaved roads connecting these facilities to more major transportation routes.

Nitrogen Oxide Increment Consumption

One of the most significant issues facing the Wyoming portion of the Basin is potential consumption of the NO_x Prevention of Significant Deterioration increment due to the rather phenomenal growth in combustion sources there. The coal bed methane development has spurred large growth of low level sources at ground level. None of these sources are typically large enough to trigger Prevention of Significant Deterioration, but nonetheless the sheer volume may be affecting the State's compliance with the National Ambient Air Quality Standard and Prevention of Significant Deterioration increment for Nitrogen Oxides. According to Bernard Dailey of the Wyoming Air Quality Division, his division is "processing thousands of permits for compressor engines and there is no end in sight".⁷ Until recently, most of these permits either did not include modeling or had applied highly simplified dispersion modeling.

To determine the extent to which the NO_x increment is being consumed, the Wyoming Department of Environmental Quality has embarked on a large-scale study of sources in the Basin. Since the available data on file at the agency is relatively old, it does not contain any significant detail concerning this recent growth in “new” emissions sources. This new study is including the impact of oil and gas development in addition to the more traditional sources of mining and mineral processing.⁸ Since Wyoming already requires Best Available Control Technology in its permitting process for all but insignificant sources, a finding that suggests high the consumption of the NO_x increment could mean much more aggressive source control. Currently Wyoming requires oxidation catalysts on engines down to 800 horsepower. The state has said it would consider extending that technology down to 400 horsepower, if necessary to reduce NO_x emissions.

The energy rich states of the Great Plains and Rocky Mountain West have rather consistently made statements indicating a commitment to developing energy resources with the least amount of government barriers. However, if the NO_x study for Wyoming indicates excessive increment consumption, Wyoming will have its hands tied in the sense that the U. S. Environmental Protection Agency will dictate to a large degree what the next steps will be. Limits on combustion sources or lower emission limits could be required, having the opposite effect to stimulation of energy development.

Wyoming has also stated a concern for growth in formaldehyde emissions. This would be primarily from the large growth in lean burn engine technology. While not a demonstrated problem to date, the state is in the process of doing some risk assessment evaluations for this pollutant. Depending on the outcome of that work, selective catalytic reduction may be required for formaldehyde reductions, which would further serve to restrict emission source growth in the Basin. On a more positive note, since coal bed methane of the Basin is relative void of hazardous air pollutants, there are not significant concerns for emissions of benzene, ethyl benzene, toluene or xylene. Some extended gas analyses have shown none of these hazardous components in the gas stream.

Visibility and Particulates

Coupled with the NO_x increment issue is the concern for visibility. While it is clear that NO_x alone is not the only issue in visibility impacts, its precursor effect ranks high among the list of concerns. Emissions from coal mining and trains play a large role in projected visibility problems of the Basin. And due to the rapid growth of coal bed methane extraction in areas distant from commercial power, production companies have been relying to a large extent on temporary power generation using diesel fuel to operate production equipment. All of these sources combine to have a negative impact on the highly prized visibility of Wyoming and Montana.

During some recent field inspections by the Wyoming Air Quality Division, a large number of unpermitted diesel power generator sets were observed. These had been located or, in some circumstances, relocated to well production sites to provide power where no commercial power was available. After some investigation, the Division concluded that there were a relatively large number of these units operating specifically in support of coal bed methane development. Rather than attempting to eliminate the

unpermitted sources, the Division's response was to alert the industry to get these units permitted.

Wyoming has responded to the growth in both gasoline and diesel power generators by instituting special guidance. Very recently the state has provided procedures whereby sources can get a waiver for pre-existing temporary equipment as long as they register with the state. After October 31, 2001, sources must process applications for gasoline or diesel power generators as "new sources". Of course nothing in the permitting and registration process currently provides any visibility protection so further controls may ultimately be required on such allied production equipment.

Another aspect of coal bed methane development is the impact of the physical plants on the previously undeveloped West. Consider that many of the areas currently developing coal bed methane, and many others being considered for development, are in places that have seen only antelope, buffalo and domestic cattle as their tenants. Production sites require access for construction crews, operations and maintenance staff and the variety of vendors that must service the production facilities to be productive. All of these entities travel the network of unpaved roads that crisscross this previously undisturbed territory. The visibility impact is noticeable to even the veteran construction worker, since the contrast of road dust plume is against an otherwise pristine environment. And to transport the natural gas to various markets, transmission pipelines must be constructed, causing yet more soil disturbances.

Since there is currently little monitoring for visibility or particulates in the Basin, this becomes an emerging issue for Wyoming and Montana. Based on work that Wyoming has undertaken in the southwest portion of the state, it is rather clear that Wyoming will probably precede Montana in defining the scope of the problem and eventually regulating sources from a visibility and particulate control perspective. It is the rapid growth in particulates that has the states wondering if there is a Non-Attainment Area concern for particulates caused by this unexpected and rapid growth of emissions sources.

Air Regulatory Issues for Coal Bed Methane Development

Wyoming has been fairly responsive to the growth issues regarding coal bed methane. The agency website has a variety of forms and guidance directed specifically to the coal bed methane industry. The site includes forms for filing permit applications, calculating emissions, change of ownership forms, Best Available Control Technology worksheet, and several guidance documents on how to permit generators and to perform dispersion modeling.⁹

The Wyoming Air Quality Division has made a reasonable effort in providing regulatory guidance to the coal bed methane industry. However by its own admission, it is having substantial difficulty in providing timely permitting. For a number of reasons, the Division cannot process permit applications any more quickly than the Wyoming statutory timeframes. The coal bed methane industry can expect construction permit applications for minor sources to take up to 150 days, assuming there are no special circumstances or issues regarding completeness and the analysis for Best Available

Control Technology. And as always, the Environmental Protection Agency can exercise oversight authority to further lengthen the process.

One minor issue in the permitting process that has substantial potential for impact on timely permit issuance relates to near-source ambient air impacts. The Division has been requiring that the exhaust stacks of all compressor engines are 1.5 times higher than the tallest building at the facility under consideration. This requirement provides for improved dispersion characteristics with respect to building downwash influences; however, it does have some undesirable outcomes for industry. If a typical-sized compressor building is anticipated for a facility, the stack height could warrant special engineering and installation efforts. Several producers have resorted to using “shed-type” structures to avoid the negative aspects related to this provision in the Division’s guidance.

Perhaps a more significant impact to timely permit issuance in Wyoming is staffing. The Division has been experiencing substantial difficulty in hiring and retaining permit engineers. The low pay scale relative to technical professional staff and the competitiveness in the environmental industry keep staff retention at a very low level. When experienced permit engineers leave the Division, or move to other positions within the Division or the Department of Environmental Quality, it takes a long time to recruit, hire and train new staff. To some extent, agencies like the Wyoming Air Division act as the training ground for staff aggressively recruited by consulting firms and industry alike.

The overall efforts by the Wyoming Air Quality Division appear to reflect what many in the industry hope is a sign of the kind of cooperation that can continue during the evolution and maturation of the industry as it attempts to develop this relatively unique energy resource.

Conclusion

When one considers the history and nature of the Great Plains and the Rocky Mountain West, it seems that the proposed development and extraction of natural gas within coal deposits is on a much faster timeline than the larger environment that holds that resource. Population and industrial growth in western states has followed a rather gradual, albeit constant, development curve. The demand for natural gas and associated energy resources is high and can only spur development to faster and greater growth. But the regulatory infrastructure has been designed for periods of slower growth and lesser demand.

Industry and government will need to address this issue in a unified manner, acknowledging the issues both entities face and keeping in mind that responsible resource development can continue while protecting the environment.

References

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