John V. Molenar Comments on BLM's Draft EIS

REVIEW OF: Draft Environmental Impact Statement and Draft Planning Amendment for the Powder River Basin Oil and Gas Project (WY-070-02-065)

John V. Molenar, Air Resource Specialists, Inc., Ft. Collins, CO 80525, April 12, 2002

Executive Summary:

The Coal Bed Methane (CBM) and related development proposed by the Bureau of Land Management (BLM) in the Wyoming Powder River Basin and described in "Draft Environmental Impact Statement and Draft Planning Amendment for the Powder River Basin Oil and Gas Project (WY-070-02-065), January 2002", (PRBO&G DEIS) will result in massive increases in the cumulative regional emissions of air pollutants. The PRBO&G DEIS allocates only 12 of a 750+ page document in a mediocre attempt to describe and minimize the impact of the increased emissions on ambient air quality and visibility throughout the region. Ten (10) times in those 12 pages the statement "reasonable, but conservative" is used as a "feel-good" adjective to lull and convince the reader that the air quality impact analysis performed for the PRBO&G DEIS is scientifically sound and has made an appropriate estimate of the "Maximum" possible impact of the proposed development. Thus, supporting the conclusion that:

"Significant air quality impacts would not occur under this Alternative. No violation of applicable state, tribal or Federal air quality regulations or standards are expected to occur as a result of direct, indirect, or cumulative CBM and non-CBM development-related air pollutant emissions (including construction and operation)" (PRBO&G DEIS 4-103)

This conclusion is based on an air quality impact modeling effort completed by Argonne National Laboratory for the BLM and described in: "Preliminary Draft Technical Support Document Air Quality Impact Assessment for the Powder River Basin Oil and Gas Development, January 2001" (Argonne). The detailed critical review of both the PRBO&G DEIS and Argonne described in the following document conclusively shows that, while this air quality impact analysis was initially framed in an accepted technique, the analysis, as completed deliberately, underestimates the actual increase in emissions, is scientifically unsound and incomplete, and therefore, seriously underestimates potential ambient air quality impacts throughout the region. In addition to the underestimation of ambient air quality impacts, it is shown that even when Argonne's flawed visibility impact analysis indicates an adverse significant impact at a number of Class I areas, the PRBO&G DEIS deliberately misrepresents and ignores the results reported by Argonne.

The need for the United States to develop its own energy resources is apparent. However, there is no requirement that significant areas of the United States be turned into "National" sacrifice zones while developing these resources. Our local, state, and national environmental regulations and guidelines mandate that the air quality impacts of such development are to be analyzed in an unbiased scientifically supported manner; and they are to be reported completely and honestly to the concerned public for review. The PRBO&G DEIS spectacularly fails to meet these requirements. The conclusion of no significant adverse air quality or visibility impacts arrived at by Argonne and reported in the PRBO&G DEIS does not meet the legal requirements for professional integrity, it is at best incompetent and scientifically unsubstantiated, and at worst, it is possibly fraudulent

Cover Letter:

April 12, 2002

Paul Beels
Bureau of Land Management
1425 Fort St.
Buffalo, WY 82834

Dear Mr. Beels:

Enclosed is my review of the "Draft Environmental Impact Statement and Draft Planning Amendment for the Powder River Basin Oil and Gas Project (WY-070-02-065), January 2002", (PRBO&G DEIS). While my review has been examined by a number of my colleagues, all analyses and opinions expressed are solely my own. I am an Atmospheric Physicist and owner of Air Resource Specialists, Inc. I have been involved in research, monitoring, modeling, and analysis of visibility and air quality issues for over 25 years. My company is a visibility/air quality/permitting contractor to (among others) the National Park Service, U.S. Forest Service, Bureau of land Management, U.S. Fish and Wildlife Service, the western states of Arizona, Colorado, New Mexico, and Wyoming, and many private business's in the west. During the past 20 years, I have been an active participant in every major visibility studies in the western United States. As well as my work as an atmospheric scientist, I have also been an active participant in western air quality policy organizations. I was a member of the Grand Canyon Visibility Transport Commission's (GCVTC) Aerosol and Visibility and Public Advisory (PAC) Committees. As a member of the GCVTC PAC, I was deeply involved in preparing the GCVTC report: "Recommendations for Improving Western Vistas, Report of the Grand Canyon Visibility Transport Commission (GCVTC) to the United States Environmental Protection Agency". I am currently a member of the Western Regional Air Partnership (WRAP) Aerosol, Monitoring, and Research and Development Forums. The WRAP is the regional planning organization (RPO) that will be developing guidelines for western states to comply with Regional Haze as well as other air quality regulations. I believe that I am highly qualified to offer my opinions on the PRBO&G DEIS.

My review is extremely critical of the air quality and visibility analysis sections of the PRBO&G DEIS and the Technical Support Document prepared by Argonne National Laboratory. I believe that the DEIS and Argonne's report are scientifically and technically unsound and that the DEIS conclusion of "No Significant" air quality and visibility impacts from the proposed development is completely unsupported.

I hope that my critical assessments of the shortcomings of the PRBO&G DEIS are used to improve the final EIS.

Sincerely;

John V. Molenar
Vice President

REVIEW OF
Draft Environmental Impact Statement
and
Draft Planning Amendment
for the
Powder River Basin Oil and Gas Project

(WY-070-02-065)

U.S. Department of the Interior
Bureau of Land Management
Wyoming State Office
Buffalo Field Office
January 2002
Prepared by
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April 12, 2002

1.0 INTRODUCTION

The following is a review of: "Draft Environmental Impact Statement and Draft Planning Amendment for the Powder River Basin Oil and Gas Project (WY-070-02-065), January 2002", herein called PRBO&G DEIS. The major focus of this review is the air quality modeling effort completed by Argonne National Laboratory for the Bureau of Land Management (BLM) and described in: "Preliminary Draft Technical Support Document Air Quality Impact Assessment for the Powder River Basin Oil and Gas Development, January 2001", herein called Argonne. The modeling effort was specifically designed to address:

> *Issue 6: The effects of the additional development of oil and gas resource on air quality and visibility*

as identified in PRBO&G DEIS. With regards to *Issue 6*, the main conclusion of PRBO&G DEIS is:

> "Significant air quality impacts would not occur under this Alternative (1, 2 or 3). No violation of applicable state, tribal, or Federal air quality regulations or standards are expected to occur as a result of direct, indirect, or cumulative CBM and non-CBM development-related air pollutant emissions (including construction and operation)" (PRBO&G DEIS 4-103)

This conclusion is completely based on analyses presented in Argonne.

After careful critical review of PRBO&G DEIS and Argonne, I believe that:

- The conclusion of No Air Quality Impacts presented in PRBO&G DEIS is incorrect, misleading, and unsupported by the flawed, incomplete, incompetent analyses provided to uphold the conclusion.

- Argonne has significant problems due to: (1) unverified and uncritically accepted performance of the CALMET/CALPUFF model system; (2) a large underestimation of the increased emissions in the modeling domain; and (3) a highly flawed "refined" visibility impact analysis that leads to a severe underestimation of the potential visibility impacts of the proposed development.

- The summary (Tables 4-14 & 4-15) and text description (pages 4-109 to 4-112) of potential visibility impacts presented in PRBO&G DEIS is extremely misleading and possibly fraudulent because it deliberately misrepresents significant visibility impacts at Class I areas reported in Argonne when using the recommended FLAG visibility screening analysis.

2.0 ARGONNE ANALYSIS

The PRBO&G DEIS /Argonne air quality impact analysis is based on:

- The assumption that use of the Environmental Protection Agency (EPA) approved dispersion model system (CALMET/CALPUFF-Version V), best available engineering assumptions, an accurate emission inventory, and appropriate meteorological data can accurately model the incremental and cumulative impacts of increased emissions in the Powder River Basin and modeling domain (315,000 km^2) on near-field and far-field ambient air quality and visibility in distant (> 100 km) Class I areas;

- The assumption that current observed ambient air quality at a limited number of near-field and far-field sites (Gillette, Sheridan, Pinedale, and Devils Tower, Wyoming) and visibility data at two Class I areas (Badlands National Park, South Dakota and Bridger Wilderness, Wyoming) adequately represent all the impact of existing regional emissions on air quality and visibility throughout the modeling domain;

- The assumption that the emissions of all projected new PRBO&G Project sources, all previously permitted sources, and all Reasonably Foreseeable Development (RFD) sources not directly associated with the PRBO&G project are accurately accounted for in a new updated emission inventory; and

- The concept that potential impacts of PRBO&G and RFD sources can be examined individually and cumulatively by running CALMET/CALPUFF with the respective sources turned on and off and adding the maximum modeled pollutant concentrations to the appropriate measured existing air quality and visibility data.

2.1 Air Quality Modeling System and Protocols

Argonne employed the current version of CALMET/CALPUFF (Version V) modeling system initialized with 1990 mesoscale meteorological model (MM4) wind field data. The modeling system, modeling domain, selected CALPUFF options, meteorological data, background ozone, ammonia and nitrogen dioxide concentrations, and other operational details are based on well accepted air quality modeling practices and assumptions. The model was used to:

"*…The outputs from the air quality modeling were used to assess potential impacts on near-field and far-field Air Quality Related Values (AQRVS.). Air quality assessments were conducted (1) by comparing potential air quality impacts predicted to result from the PRBO&G project (and Alternatives) emissions alone, all other new and RFD sources emissions alone, and all sources emissions combined (cumulative) to the applicable Prevention of Significant Deterioration (PSD) increments (Class I or Class II depending on receptor location), and (2) by comparing the potential total concentrations (direct cumulative air quality impacts plus existing baseline concentration) to the applicable National Air Quality Standards (NAAQS) and applicable State Ambient Air Quality Standards (SAAQS)…*" (Argonne p.9)

This concept of incremental emission analysis by modeling specific sources separately and together in different model runs is a standard air pollution analysis technique. Employing the CALMET/CALPUFF modeling system in this fashion is the currently accepted procedure (IWAQM, 1998 and FLAG, 2000). In addition, Argonne states that (p. 1):

> "*…Before Argonne initiated its study, an Air Quality Assessment Protocol document that describes Argonne's plans for conducting the study was prepared with inputs from stakeholders. The stakeholders include BLM, Federal Land Managers (FLMs) of affected areas, EPA, Departments of Environmental Quality (DEQs) of affected states, industries proposing new development, environmental groups including the Wyoming Outdoor Council, and the Northern Cheyenne Tribal Council. Argonne made its best efforts to follow the protocol as closely as practically possible…*"

The Air Quality Assessment Protocol document was not available for review, thus this statement cannot be verified.

The Argonne CALMET/CALPUFF modeling exercise for incremental Prevention of Significant Deterioration (PSD) analysis is well within established procedures. However, NO uncertainty analyses are presented that discuss the confidence intervals of these modeled impacts. Both PRBO&G DEIS and Argonne list the results of the model assessment of impacts as if they are

EXACT, which is ridiculous science as well as incredibly misleading. Two (but not all) significant issues that must be addressed before any confidence can be assigned to the reported results are (1) for NAAQS and PSD analyses, does the CALMET/CALPUFF system applied to the PRBO&G modeling domain generate unbiased maximum pollutant increments at the sensitive receptors? and (2) for visibility analyses, are the modeled daily incremental change in aerosol and gaseous species concentrations at the receptors good to a factor of 2, 10 or 100?

A prime (but not the only) example of the fallacy of uncritical acceptance of modeled outputs that permeates the Argonne analysis is taken directly from Table 7-2 of Argonne, 2001. The table indicates that the maximum 24-hour $PM_{2.5}$ incremental impact due to cumulative sources under Alternative 1 (39,367 CBM wells) is 18 $\mu g/m^3$, while it is 20 $\mu g/m^3$ under Alternative 3 (15,458 CBM wells)! This is the type of ABSURD result (drilling more wells will clean up the atmosphere) that occurs when models are run without performance evaluations and the results are accepted without a critical review of the model input, output, or without a thorough understanding of atmospheric processes being simulated. Argonne appears to use the CALMET/CALPUFF modeling system as a simple engineering exercise rather than a sound scientific analysis of potential impacts.

2.2 Existing Air Quality Data

Argonne used the most current existing ambient air quality data for the PRBO&G project and surrounding areas in the analyses of NAAQS and SAAQS (EIC, 2000). The key assumption is that this limited data can adequately characterize existing air quality throughout the modeling domain such that a determination if all pertinent NAAQS and SAAQS are met can be made by adding the maximum modeled pollutant concentrations from new sources to the maximum observed pollutant concentrations at Gillette, WY. Unless data indicating that the maximum pollutant concentrations used as the baseline are lower than maximum measured values at some other location in the PRBO&G project area are put into evidence, this assumption is the only estimate that can be made. Argonne presents limited evidence that they examined this assumption in any detail.

2.3 Emission Inventory

The key to a successful modeling effort examining potential impacts from any proposed development is an extensive accurate accounting of ALL possible emissions resulting from ALL possible sources related to the project. The key to a cumulative impact analysis of many projects requires the same commitment to generating an extensive accurate emission inventory for ALL permitted, planned, and RFD projects. Argonne states (p. 13):

> "*…The emission inventory database developed for the current study was submitted to interested stakeholders, including state DEQs, for their review. Stakeholders' comments were reflected as appropriate in the final emission inventory database, including the data on emissions associated with the proposed PRBO&G project and other new and RFD sources within the modeling domain…*"

There is no record of an independent detailed critical examination of this emission database to back up this statement. Without such an examination, it cannot be guaranteed that the emission database presented in Argonne and all calculations such as: specific emission rates for compressors, fugitive dust generated by construction activities, pollutant emissions and road dust by vehicle type, estimated vehicle miles, etc. adequately describe the proposed sources.

2.3.1 Fugitive Dust

A specific problem area of the emission inventory is that existing techniques for estimating fugitive dust emissions are incomplete, inadequate, and probably severely underestimate the actual PM_{10} and $PM_{2.5}$ emissions. Table 1 lists the reported PM_{10} and $PM_{2.5}$ fugitive dust emissions for the four counties in the PRBO&G project area for 1990, 1995, and 1999 (U.S.EPA, 2002). The total estimated emissions of PM_{10} and $PM_{2.5}$ in these counties is dominated by the fugitive dust category. However, the reported emissions change wildly from 1990 - 1995 - 1999. This is primarily a function of varying specific fugitive dust emission rates between reporting periods, rather than any drastic change in land use! The specific fugitive dust emission rates used in Argonne should be revisited in light of new information that is available.

Table 1

Fugitive Dust Emission History PRBO&G Counties

REPORTED FUGITIVE DUST EMISSIONS

PRBO&G COUNTIES (1990, 1995 & 1999)

U.S. EPA, 2002

	Tons/Year		% of Four County Total (All: Area and Point Sources)	
	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Campbell Co	9,265	1,506	30.8%	24.1%
Converse Co	4,375	695	14.5%	11.1%
Johnson Co	2,243	365	7.5%	5.8%
Sheridan Co	7,141	1,143	23.7%	18.3%
1990 Total	23,024	3,709	76.5%	59.4%

Campbell Co	41,445	6,344	34.9%	27.9%
Converse Co	20,965	3,189	17.7%	14.0%
Johnson Co	10,102	1,549	8.5%	6.8%
Sheridan Co	33,240	5,061	28.0%	22.2%
1995 Total	105,752	16,143	89.1%	70.9%
Campbell Co	24,608	3,818	32.2%	22.8%
Converse Co	12,658	1,959	16.5%	11.7%
Johnson Co	6,377	1,013	8.3%	6.0%
Sheridan Co	19,653	3,034	25.7%	18.1%
1999 Total	63,296	9,824	82.7%	58.6%

A recent report prepared for the Western Regional Air Partnership by a panel of experts (WGA, 2001) has extensively examined the issue of fugitive dust. Specific findings from this effort that apply directly to this impact analysis are:

- Fugitive dust emission factors need to be appropriate.
- Fugitive dust emissions are not continuous processes.
- Source activity levels need to be accurate.
- Annual fugitive dust emission inventories are not sufficient.
- Spatial allocation of fugitive dust emissions is important.
- The fine fraction of fugitive dust emissions is not adequately characterized.
- Disturbed surfaces produce significantly more fugitive dust than undisturbed surfaces.

The PRBO&G project will result in short-term disturbance of over 200,000 acres and long-term disturbance of over 100,000 acres (PRBO&G DEIS, p. 4-87). This will include over 17,000 miles of new gravel/dirt roads (Argonne, p.6) that: "*...the Companies would not routinely employ dust abatement procedures on...*" (PRBO&G DEIS, p. 2-34)! The PM_{10} and $PM_{2.5}$

emissions from fugitive and road dust used in this analysis are probably incorrect. Since, fugitive dust primarily effects near-field air quality, the estimated maximum near-field impacts predicted in Argonne may be significantly underestimated.

2.3.2 Out-of-Date Inventory

The emission inventory used in Argonne is also out-of-date. Argonne states (p. 19):

"*…The permit cutoff date for new sources to be included in the updated emission inventory database (August 31, 2000) was selected at the stakeholders meeting held in Buffalo, Wyoming on August 3, 2000. Similarly, the RFD projects are those clearly defined as of August 31, 2000, as the sources reasonably expected to be in operation within the next 10 years...*"

Thus, since the emission database was frozen as of August 31, 2000, no sources proposed or considered for proposal after that date are examined in the Argonne analysis. Sources known to have been left out of the emission inventory include but are not limited to:

- The modeling effort only accounted for 39,367 new CBM wells and ancillary facilities. Current analyses of potential CBM development state a probable number of 80,000 new CBM wells and a high development scenario of 139,000 CBM wells (Wyoming State Office, 2001);

- The proposed 10,000 new CBM wells and ancillary facilities for the Montana portion of the Powder River Basin (BLM, 2002); and

- Three new major coal-fired power generating stations that have applied for permits: Black Hills Power-WYGEN, North American Power's Mid-PRB, and Two Elks #2. (Shepherd, 2002)

2.3.3 Missing Sources

Finally, it appears that at least three major sources of emissions directly associated with the proposed PRBO&G Project are not included in the Argonne analysis:

- Increased road dust emissions due to increased non-project travel (recreational, curiosity, miscellaneous) on new dirt roads developed specifically for the PRBO&G project;

- Increased wind blown dust from surfaces disturbed by CBM development due to the fact that disturbed surfaces produce significantly more fugitive dust than undisturbed surfaces (WGA, 2001); and

- Methane and other organic gases directly vented to the atmosphere from CBM wells.

- **2.3.4** Estimated Emission Increase

Even with the exclusion of the above mentioned sources, the identified proposed increase in emissions from CBM development is significant. Table 2 lists the 1990, 1995, and 1999 area and point source emissions for the state of Wyoming, the four Wyoming counties (Campbell,

Converse, Johnson, and Sheridan) in the PRBO&G project area (U.S.EPA, 2002), and the estimated 2006 increase of emissions that are in the Argonne emission inventory (Argonne, 2001). The projected increase in emissions for the four counties are:

- CO 49% increase
- NO_X 52% increase
- PM_{10} 7% increase
- $PM_{2.5}$ 9% increase
- SO_2 6% increase
- VOC 106% increase

By 2006 all modeled sources will increase yearly emissions in the modeling domain by:

- CO 29,868 tons/year increase
- NO_X 45,070 tons/year increase
- PM_{10} 7,288 tons/year increase
- $PM_{2.5}$ 1,986 tons/year increase
- SO_2 9,232 tons/year increase
- VOC 11,527 tons/year increase

It is important to note that nowhere in PRBO&G DEIS are these projected increases in emissions actually presented. Since, any non-technical reviewer, the public, or the press will probably not actually look at Argonne, these large figures will tend to remain very obscure.

With respect to the requirement for all states and tribes to develop State Implementation Plans (SIPS) and Tribal Implementation Plans (TIPS) that achieve reasonable progress toward the National Regional Haze goals of NO decrease in visual air quality on the 20% cleanest days and improving visibility on the 20% worst days in their respective Class I areas (U.S.EPA, 1999), even these proposed severely underestimated increases in emissions will be of great concern. As recommended by the Grand Canyon Visibility Transport Commission in 1996 (GCVTC, 1996):

> " *… Reasonable progress towards the national visibility goal is achieving* ***continuous emission reductions*** *(emphasis added) necessary to reduce existing impairment and attain steady improvement of visibility in mandatory Class I areas and managing emissions growth so as to prevent perceptible degradation of clean air days...*"

Thus, the reported (but highly under estimated) cumulative increase in emissions are in direct contradiction of national visibility goals.

Table 2

PRBO&G Project Emission Inventory Analysis

WYOMING: TONS/YEAR		CO	NO_X	PM_{10}	SO_2	VOC	$PM_{2.5}$
	Area	272,057	106,219	158,305	18,167	46,421	31,580
	Point	17,902	139,051	8,490	124,428	20,062	4,029
1990	Total	289,958	245,270	166,795	142,595	66,482	35,609
	Area	292,898	121,260	595,510	19,263	48,763	97,063
	Point	75,664	155,355	33,483	159,704	22,371	17,907
1995	Total	368,562	276,616	628,993	178,967	71,134	114,970
	Area	301,823	133,083	376,140	19,482	47,305	64,731
	Point	75,073	142,394	31,315	154,911	21,146	18,796
1999	Total	376,896	275,477	407,455	174,393	68,451	83,527
PRBO&G Counties: Tons/Year		CO	NO_X	PM_{10}	SO_2	VOC	$PM_{2.5}$
	Area	40,945	11,343	27,869	3,044	6,543	5,213
	Point	4,142	29,649	2,212	34,068	741	1,034
1990	Total	45,088	40,992	30,080	37,112	7,284	6,247
	Area	43,974	12,952	110,763	3,121	6,967	17,632
	Point	5,152	35,615	7,936	45,988	2,873	5,145
1995	Total	49,126	48,567	118,698	49,110	9,840	22,777
	Area	53,818	16,670	68,933	3,318	7,501	11,491
	Point	4,801	31,381	7,595	38,673	2,930	5,282
1999	Total	58,619	48,051	76,528	41,991	10,431	16,773
	Area	31.4%	47.0%	147.3%	9.0%	14.6%	120.4%
	Point	15.9%	5.8%	243.4%	13.5%	295.3%	410.9%
% Change 1990 - 1999	Total	30.0%	17.2%	154.4%	13.1%	43.2%	168.5%
	Area	22.4%	28.7%	-37.8%	6.3%	7.7%	-34.8%

% Change 1995 - 1999	Total	19.3%	-1.1%	-35.5%	-14.5%	6.0%	-26.4%
2006 Estimated Emission Increase in PRBO&G Counties		CO	NO_X	PM_{10}	SO_2	VOC	$PM_{2.5}$
PRBO&G Proposed New 39,367 CBM Wells		13,851	13,995	2,508	357	8,113	1,099
PRBO&G Proposed New 3,200 Conventional Oil & Gas Wells		948	3,839	396	467	156	181
Increase From Existing Coal Mines		4,776	2,744	2,229	301	252	0
Permitted New 12,077 CBM Wells		8,834	4,530	364	1,469	2,552	270
Total 2006 Increase: Tons/Year		28,409	25,108	5,497	2,594	11,073	1,550
2006 Increase % of 1999 Emissions		48.5%	52.3%	7.2%	6.2%	106.2%	9.2%
Permitted and RFD Sources in Modeling Domain Outside PROB&G Counties		1,459	19,962	1,791	6,638	454	436
Total Estimated Increase In Emissions: Tons/Year		29,868	45,070	7,288	9,232	11,527	1,986

2.4 Air Quality Impacts

2.4.1 NAAQS and SAAQS

Compliance, with the appropriate NAAQS and SAAQS for criteria pollutants (NO_2, SO_2, PM_{10}, $PM_{2.5}$, CO and O_3), is estimated by determining the appropriate (annual, 24-hour, 8-hour, 3-hour, or 1-hour) maximum modeled cumulative increment in pollutant concentrations at a receptor for the 1990 model year and adding this increment to the measured appropriate (99^{th} percentile, 4^{th} highest maximum, etc.) maximum concentration for the same time increment. This is a conservative screening estimate: if the NAAQS or SAAQS are not exceeded by this analysis, there is a very high probability that they will not be exceeded at any time at the receptor by the estimated cumulative increase in emissions. This analysis depends on the accuracy and completeness of the emission inventory used, how representative and accurate the measured maximum pollutant concentrations are, and the ability of the modeling system to make non-biased estimates of maximum pollutant concentrations at the receptor.

Argonne reports compliance with all existing NAAQS and SAAQS in the region for the cumulative emission increase analysis. But, as pointed out in previous sections, the Argonne emission inventory is seriously incomplete, the maximum measured ambient pollutant concentrations are from a very limited data set, and no analysis of the performance of the CALMET/CALPUFF system in this region is presented.

Thus, the PRBO&G DEIS analysis is incomplete and the PRBO&G DEIS statement that

"*Significant air quality impacts would not occur*" is premature, unsupported, and at best speculative.

2.4.2 PSD Increments

Compliance with the appropriate (Class I or Class II) PSD increment for criteria pollutants (NO_2, SO_2, PM_{10}, $PM_{2.5}$, CO and O_3) is estimated by locating the appropriate (annual, 24-hour, 8-hour, 3-hour, or 1-hour) maximum modeled cumulative increment in pollutant concentrations at a receptor for the 1990 model year and comparing the value to the allowed PSD increment. This is a conservative screening estimate: if the PSD increments are not exceeded by this analysis, there is a very high probability that they will not be exceeded at any time at the receptor by the estimated cumulative increase in emissions. This analysis depends on the accuracy and completeness of the emission inventory used and the ability of the modeling system to make non-biased estimates of maximum pollutant concentrations at the receptor.

Argonne reports compliance with all PSD increments for criteria pollutants in the region for the estimated cumulative increase in emissions. But, as pointed out in previous sections, the Argonne emission inventory is seriously incomplete and no analysis of the performance of the CALMET/CALPUFF system in this region is presented.

Thus, the PRBO&G DEIS analysis is incomplete and the PRBO&G DEIS statement that "*Significant air quality impacts would not occur*" is premature, unsupported, and at best speculative.

2.5 Visibility Impacts

The U.S. Congress has given Federal Land Managers a very powerful mandate to protect visibility in all Class I areas of the U.S. The extent of this mandate can be seen in the following passage from Senate Report No. 95-127, 95th Congress, 1st Session, 1977 which states (FLAG, 2000):

> "*The Federal Land Manager holds a powerful tool. He is required to protect Federal lands from deterioration of an established value, even when Class I [increments] are not exceeded. ... While the general scope of the Federal Government's activities in preventing significant deterioration has been carefully limited, the FLM should assume an aggressive role in protecting the air quality values of land areas under their jurisdiction. In cases of doubt the land manager should err on the side of protecting the air quality-related values for future generations*."

In 1999, the EPA promulgated a Final Regional Haze Rule (U.S.EPA, 1999) that places the responsibility on States and Tribes to work cooperatively with regional States and Tribes to manage emissions in their respective boundaries to meet the National Visibility Goals of improving visibility on the worst days and preserving visibility on the best days.

Estimation of visibility impacts requires substantially more detailed and sophisticated analyses than analyses for NAAQS and PSD compliance. The analyses require modeling the daily incremental change in ammonium sulfate (Sulfate), ammonium nitrate (Nitrate), organics (OMC), light absorbing carbon (LAC), fine soil (Soil), PM_{10}, $PM_{2.5}$, and nitrogen dioxide (NO_2) mass concentrations at the Class I area receptors due to the cumulative impact of all new proposed emissions. Then calculating the incremental change in extinction associated with the increased species concentrations accounting for the effects of relative humidity on the extinction efficiency of ammonium sulfate and ammonium nitrate:

$$\Delta b_{ext}\ (Mm^{-1}) = 3.0\ f(rh)[Sulfate]+3.0f(rh)[Nitrate]+4.0[OMC]+10.0[LAC]+1.0[Soil]+0.6[CM]+0.17[NO_2] \quad (1)$$

where:

$\Delta b_{ext}\ (Mm^{-1})$	=	calculated incremental change in extinction coefficient
f(rh)	=	relative humidity weighting function
[Sulfate]	=	incremental change in Ammonium Sulfate - $\mu g/m^3$
[Nitrate]	=	incremental change in Ammonium Nitrate - $\mu g/m^3$
[OMC]	=	incremental change in Organics - $\mu g/m^3$
[LAC]	=	incremental change in Light Absorbing Carbon - $\mu g/m^3$
[Soil]	=	incremental change in Fine Soil - $\mu g/m^3$
[CM]	=	incremental change in Coarse Mass (PM_{10}-$PM_{2.5}$) - $\mu g/m^3$
$[NO_2]$	=	incremental change in Nitrogen Dioxide - $\mu g/m^3$

These daily values are then used with some baseline extinction (b_{base}) value to estimate the visual air quality impact by calculating the change in deciview (dv) from some baseline extinction (b_{base}):

$$\Delta dv = 10.0\ \ln([b_{base} + \Delta b_{ext}]/10.0) - 10.0\ \ln(b_{base}/10) \quad (2)$$

The daily values of Δdv for the modeling year are then examined for specific threshold analyses. Typically a $\Delta dv = 0.5$ is considered a significant impact and a $\Delta dv = 1.0$ is considered an adverse impact (FLAG, 2000). The implications of this are severe. The lower (better visibility) the baseline extinction used, the smaller (less cumulative emission increase) Δb_{ext} before thresholds are tripped. The higher (worse visibility) the baseline extinction used, the larger (greater cumulative emission increase) Δb_{ext} before thresholds are tripped.

Argonne presents details of the visibility impact analyses done for PRBO&G DEIS (Argonne, 2001 Appendix D & F). Argonne uses the following equation to calculate Δb_{ext}:

$$\Delta b_{ext}\ (Mm^{-1}) = 3.0\ f(rh)[Sulfate]+3.0f(rh)[Nitrate]+1.0[PM_{2.5}] \quad (3)$$

Equation 3 is INCORRECT and INCOMPLETE:

- Modeled increase in Organics, LAC, Coarse Mass (PM_{10}-$PM_{2.5}$) or NO_2 at any of the Class I receptors are ignored. Argonne justifies this by stating (without proof) that incremental changes in Organic, LAC, and NO_2 concentrations at the Class I receptors due to increased emissions are not significant. But, no examples of such calculations are presented just the assumption: this results in an under-estimation of Δb_{ext};

- [$PM_{2.5}$] is used in place of Fine Soil: this results in an over-estimation of Δb_{ext}; and

In general, I believe that the combination of the above errors will result in an underestimation of modeled Δb_{ext}; thus, an underestimation of projected visibility impacts!

2.5.1 FLAG and Wyoming Screening Analyses

The FLMs are concerned about situations where a change in extinction from new source growth is greater than 5% ($\Delta dv = 0.5$) as compared against natural background. Changes in extinction greater than 10% ($\Delta dv = 1.0$) are generally considered unacceptable by the FLMs and will likely raise objections to further pollutant loading without mitigation (FLAG, 2000).

FLAG has set specific seasonal "natural background" b_{ext} and specific seasonal f(rh) values for each Class I area (FLAG, 2000). These are to be used as a screening analysis for visibility impacts by setting the baseline b_{ext} equal to the natural background b_{ext}.

The State of Wyoming DEQ has established baseline b_{ext} as the average of the extinction on the cleanest 20% of days at Badlands National Park and Bridger Wilderness. Since, these values will typically be greater than the assumed FLAG natural background, Δdv calculated with the Wyoming DEQ baseline b_{ext} will be lower than using the FLAG baseline b_{ext} (It takes a greater change in Δb_{ext} to trigger impacts using the Wyoming baseline b_{ext}).

Argonne reports the results (using the above FLAWED calculation) of such analyses for the Class I and Class II areas in the PRBO&G modeling domain using both FLAG (for both Class I and II areas) and Wyoming DEQ (for Class I areas only) baseline b_{ext}. They are listed in Table 3. Even with the incorrect calculation of Δb_{ext}, significant adverse visibility impacts result using either FLAG or Wyoming DEQ screening levels!

It is must be pointed out that while PRBO&G DEIS states:

"*... Table 4-14 uses the "Final Flag Phase I Report" procedures for this NEPA analysis*

..." (p. 4-110) and

"*…The visibility impact analysis assumed seasonal "natural background" optical conditions would occur simultaneously every day throughout each mandatory Federal PSD Class I Area, and that a 1.0 deciview "just noticeable change" would be a reasonably foreseeable significant adverse impact…*" (p. 4-111)

This statement implies that the FLAG Natural Background Screening analysis was used and is reported in the DEIS. Table 4-14 of the PRBO&G DEIS lists the number of days with a $\Delta dv\ 0 \geq 1.0$ at Badlands, Bridger, Fitzpatrick, N. Absaroka, N. Cheyenne, Washakie, and Wind Cave as: 3, 0, 0, 1, 10, 1 and 4 respectively. However, Table 3 shows that the Argonne reported days with a $\Delta dv\ 0 \geq 1.0$ using the FLAG procedures are: 69, 9, 1, 2, 54, 2, and 85 respectively (Argonne, 2001). This is a deliberate fraudulent misrepresentation of the visibility screening analysis results as reported in Argonne!!!

It appears that the authors of the PRBO&G DEIS decided to ignore the severity of this analysis and to only present the results of the refined analysis (a fatally flawed analysis - discussed in the next section) which indicates MUCH LOWER VISIBILITY IMPACTS! This appears to me to be a deliberate, possibly fraudulent, attempt by the BLM to obfuscate and minimize the serious potential visibility impacts of the proposed and planned development in the Powder River Basin at the Northern Cheyenne Indian Reservation, and Badlands and Wind Cave National Parks.

Table 3

Calculated Visibility Screening Impacts at

Class I Areas From PRBO&G (Alt. 1) and Cumulative Sources - Argonne, 2001

•		• PRBO&G SOURCES ALTERNATIVE 1		• CUMULATIVE SOURCES	
• Class I Areas	• Screening Procedure	• Number of days • $\Delta dv \geq 0.5$	• Number of days • $\Delta dv \geq 1.0$	• Number of days • $\Delta dv \geq 0.5$	• Number of days • $\Delta dv \geq 1.0$
•	•	•	•	•	•
• Wind Cave NP	• FLAG	• 44	• 18	• 153	• 85
	• WDEQ	• 32	• 8	• 115	• 63
•	•	•	•	•	•
• Badlands NP	• FLAG	• 38	• 13	• 134	• 69
	• WDEQ	• 22	• 7	• 92	• 39
•	•	•	•	•	•
• Bridger WA	• FLAG	• 7	• 1	• 11	• 9

	• WD EQ	• 7	• 1	• 11	• 9
•	•	•	•	•	•
• Washakie WA	• FL AG	• 2	• 2	• 6	• 2
	• WD EQ	• 2	• 2	• 5	• 2
•	•	•	•	•	•
• N. Absaroka WA	• FL AG	• 1	• 1	• 3	• 2
	• WD EQ	• 1	• 1	• 2	• 1
•	•	•	•	•	•
• Fitzpatrick WA	• FL AG	• 1	• 0	• 4	• 1
	• WD EQ	• 1	• 0	• 4	• 1
•	•	•	•	•	•
• Northern Cheyenne IR	• FL AG	• 49	• 21	• 108	• 54
	• WD EQ	• -	• -	• -	• -

•

NP = National Park

WA= USFS Wilderness Area

IR = Indian Reservation

2.5.2 Refined Visibility Impact Analysis

Since the recommended FLAG visibility screening analysis performed by Argonne resulted in the determination that significant adverse impacts would occur at a number of Class I areas, Argonne tries to minimize this finding by attempting a "refined" visibility analysis. However, the analysis described in Argonne is scientifically unsound, incompetent and indefensible. The results of the Argonne "refined" visibility analysis are incorrect and cannot be used in any meaningful way.

Argonne's refined analysis:

- Uses the same daily modeled incremental increase in only a few aerosol species at each Class I receptor as in the screening analysis;

- Replaces the climatological f(rh) by using the modeled vertical average relative humidity for the lowest 200m atmospheric level at the nearest MM4 grid point to the receptor. Argonne's justification is "*...The relative humidity vertical average is more representative than are distant surface measurements...*" (Argonne, 2001, p. D-3) daily average f(rh) is calculated from this modeled relative humidity;

- Daily Δb_{ext} is calculated using Equation 3; and

- Daily Δdv is calculated with Equation 2 using daily average b_{ext} measured by transmissometers at Badlands National Park and Bridger Wilderness as the base b_{ext}, rather than the FLAG or Wyoming baseline b_{ext}.

The major problems with Argonne's refined analysis are many and significant:

- As with the screening analysis, the refined analysis does not include all aerosol or gaseous species, thus minimizing the estimated impact;

- As with the screening analysis, the refined analysis uses incorrect algorithms to calculate Δb_{ext}, thus minimizing the estimated impact;

- The refined analysis implicitly assumes, without supplying any evidence, that the CALMET/CALPUFF/MM4 system can accurately model the specific daily changes in relative humidity and species concentrations at ALL receptors for the 1990 base year to compare to the specific daily measured b_{ext} at two locations;

- The refined analysis implicitly assumes that the calculated 200m specific average relative humidity at all receptors is the same as the surface relative humidity at the two b_{ext} measurement locations, thus minimizing the estimated impact; and

- No mention is made as to how daily b_{ext} values at Badlands NP or Bridger W were calculated or missing days were accounted for.

- The first two flaws have been analyzed in the previous sections. The remaining flaws will be further described.

2.5.2.1 Ability of modeling system to accurately simulate specific daily events

Argonne's refined visibility analysis implicitly assumes that the CALPUFF/CALMET/ MM4 receptor modeling system can accurately model the specific daily incremental change in extinction due to increasing emissions and add these increments to the corresponding daily measured extinction at the receptor site. This is an incredibly naive and scientifically unsound assumption. Green and Tombach (2000) have recently published an extensive evaluation of the ability of current receptor models (including CALPUFF) to replicate a specific time series of tracer concentrations in complex terrain. All models essentially had "Zero" temporal correlation with the measured tracer at all sites. They have concluded:

- " ... The policy lesson gained from this evaluation is that results of any model should not be given much credence until the model has been evaluated for conditions similar to the intended application..."

Argonne presents no evidence of any evaluation of the CALPUFF/CALMET/MM4 model performance in the PRBO&G region. Either such an evaluation was not done showing the incompetence of this work; or the evaluation was done and the results were so bad that they were ignored indicating the fraudulence of this work.

2.5.2.2 Incorrect calculation of f(rh) using 200m average relative humidity

Argonne makes a statement (p. D-3) that: *"...The relative humidity vertical average (200m vertical average at the nearest MM4 grid point) is more representative than distant surface-based measurements..."*. While this statement may have some scientific credibility when applied to meteorological analysis, it is absolutely incorrect and inappropriate when applied to specific visibility analysis.

As shown in Equation 1, Δb_{ext} is calculated from the change in aerosol species concentrations adjusted with a relative humidity growth function (f(rh)) and then compared to some baseline b_{ext} (Equation 3). f(rh) is a highly non-linear function of relative humidity (Malm et. al., 1996), i.e. - for any incremental increase in relative humidity the incremental increase in f(rh) is significantly greater. Therefore, any underestimation of relative humidity results in a greater underestimation of f(rh), thus a large underestimation of Δb_{ext}.

Since, Argonne's analysis calculates a daily f(rh) from daily 200m average relative humidity, it results in a doubly severe underestimation of the visibility impact by:

- The 200m f(rh) is much lower than the surface f(rh) thus Δb_{ext} is underestimated; and

- The baseline b_{ext} is the daily average transmissometer measured b_{ext}, which is NOT the 200m b_{ext}, but measured at approximately 10m above the surface where the f(rh), and thus the b_{ext}, is much higher.

By making a low estimate of Δb_{ext} and then comparing it to a high baseline b_{ext}, Argonne is deliberately and incorrectly minimizing the calculated daily visibility impact.

2.5.2.3 Incorrect use of daily transmissometer data

Argonne's refined visibility analysis replaces the FLAG and Wyoming baseline b_{ext} with the daily average b_{ext} as measured by a transmissometer at Badlands National Park or Bridger Wilderness. Transmissometers are sophisticated optical instruments that make hourly measurements of b_{ext}. These measurements must be carefully examined and flagged (identified) to remove interferences due to weather and other optical effects (Molenar et. al., 1990; Molenar et. al., 1992). When comparing b_{ext} calculated from daily average speciated aerosol data to transmissometer data, the hourly b_{ext} measured by a transmissometer must be filtered and combined

in some manner to derive an appropriate daily average b_{ext}. Malm et. al. (1996) examined this issue and recommended that a minimum of 18 hourly non-flagged b_{ext} values should be available before the daily average transmissometer b_{ext} is considered appropriate.

Since Argonne does not describe how the daily b_{ext} was obtained from reported transmissometer data, the historic transmissometer data from Badlands National Park and Bridger Wilderness was examined. Table 4 presents the results of this analysis listing the number of days per year that have no (0), at least 12, and at least 18 hours of valid transmissometer data for 1988-1999.

Table 4

Analysis of Transmissometer Data from Badlands National Park and Bridger Wilderness

Year	Badlands National Park Days With			Bridger Wilderness Days With		
	0 hrs valid b_{ext}	12 hrs or more valid b_{ext}	18 hrs or more valid b_{ext}	0 hrs valid b_{ext}	12 hrs or more valid b_{ext}	18 hrs or more valid b_{ext}
1988	217	121	81	47	291	274
1989	146	156	82	49	220	125
1990	48	231	132	156	153	91
1991	58	187	94	72	226	134
1992	44	243	169	126	185	106
1993	46	228	150	55	250	153
1994	43	238	149	22	279	170
1995	37	237	169	66	225	126
1996	70	203	138	43	243	143
1997	76	213	148	52	223	98
1998	54	210	131	54	232	135
1999	22	268	158	34	270	177

Argonne used 1990 as the base year for their "refined" analysis. In 1990, Badlands had 48 days and Bridger 156 days with no valid transmissometer data! Even using the less restrictive limit of at least 12 hours of valid transmissometer data to calculate a daily average rather than the recommended 18 hours (Malm et. al., 1996); the 1990 base year has 134 days at Badlands and 212 days at Bridger that would not have a valid daily average transmissometer derived b_{ext}. Argonne

makes no attempt to describe how or even if these missing days were accounted for in the analysis! This is a striking example of the incompetence of this "refined" analysis.

3.0 CONCLUSIONS

After careful critical review of PRBO&G DEIS and supporting documents I believe that the PRBO&G DEIS conclusion of:

> "*Significant air quality impacts would not occur under this Alternative (1, 2 or 3). No violation of applicable state, tribal or Federal air quality regulations or standards are expected to occur as a result of direct, indirect, or cumulative CBM and non-CBM development-related air pollutant emissions (including construction and operation)*" (PRBO&G DEIS 4-103)

is unsubstantiated and misleading.

My reasons for this conclusion are:

- The emission inventory used to model air quality and visibility impacts in the PRBO&G project domain severely underestimates known Reasonably Foreseeable Development sources, by possibly 100%. Thus, cumulative effects are not properly accounted for.

- Significant near-field and far-field air quality impacts can probably be expected if all sources are accounted for.

- The calculations presented to estimate visibility impacts from modeled speciated aerosols are incomplete and incorrect. The errors and omission of key species will tend to underestimate the calculated change in ambient extinction, and thus minimize the impact.

- Even with the existing low emission inventory and underestimation of calculated extinction increments, large significant adverse visibility impacts (more than 10 days with $\Delta dv \geq 1.0$) are predicted by the FLAG screening analyses at Badlands National Park, Wind Cave National Park, Bridger Wilderness, and the Northern Cheyenne Indian Reservation but deliberately misreported in the PRBO&G DEIS.

- The Argonne "refined" visibility analysis is completely incompetent and thus cannot be used with any confidence.

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