Dr. John D. Spengler's Comments on BLM's Draft EIS

April 11, 2002

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

Dear Mr. Beels:

Attached is the review of the Powder River Basin Oil and Gas Development Project that was done by faculty and graduate students in the Department of Environmental Health, at the Harvard University School of Public Health. We focused on the air quality aspects of the project, basing our suggestions and criticisms primarily on the Technical Support Document prepared by Argonne National Lab. These comments represent our judgment about the short comings and deficiencies of the impact analysis. Our overall opinion is that PRB Development in its entirety has the potential for serious ecological harm and health damages to the public. The Draft EIS is insufficient in both scope and thoroughness. The deficiencies in just the air quality assessment render a fair comparison among alternatives impossible and misleading to the public and decision-makers.

From the outset it must be said that the financial returns from coal, oil and gas sales of the PRB development will be in the billions of dollars per year and the potential for serious harm to the environment would seem to require a more comprehensive and thoughtful analysis effort. Among our concerns are the following issues:

Segmentation of analysis:

The analysis of the larger parcel in Wyoming was considered separately from the Montana portion. The emissions of particles, nitrogen oxides, sulfur dioxide and hazardous pollutants into the air will be transported, transformed and deposited over nearby and distant lands by air masses migrating across the area. By the basic physical principles that govern air pollution dispersion and hence health and ecological impacts, emissions from the entire area must be evaluated as a whole. If the BLM and energy companies wanted to understate the environmental impacts, an effective strategy would be (a) bifurcate the development into a Wyoming and Montana portion, (b) exclude new coal plants, expanded coal mining and rail transport, and (c) defer evaluation of wells and compressors to a future permitting stage.

National Energy Policy:

Proposed energy development will have environmental consequences for the Nation, including pollution emitted from the combustion of extracted coal, oil and methane. The Draft EIS is inadequate because it does not consider health and ecological impacts from displaced emissions resulting from the use of the fuels, even for use occurring outside of the analysis domain. At the heart of the PRB Development are fundamental issues about our nation's energy policy. Do we promote the use of fossil fuels or do we create incentives for demand-side management and expanded use of renewable energy resources? What is at stake in the PRB development is far more than the balance of local interest and mitigation of impacts in the area. Furthering the use of coal has the potential of exposing millions of Americans to harmful levels of air pollution in communities far distant from the domain defined in the draft EIS. Cleaner burning natural gas could substantially reduce the green house gas potential of methane (if we assume it would be released eventually) and displace, in part, the more harmful effects of coal-related pollutants. Energy development plans for Wyoming and Montana represent a significant fraction of our coal and gas production. Considering that coal, oil and gas will be burned in industry, electrical-generating plants and homes across the country, air pollution will also be distributed over much of the nation. It is technically feasible and, in fact, methodologies exist for quantifying the air pollution impacts on health, acidity, ozone formation and visibility from sources distributed across the country. National energy and air pollution models were used by EPA to calculate benefits and cost associated with the Clean Air Act and particle standards. Ironically, OBM requires that such analysis accompany Federal rulemaking and regulations. To require a comprehensive analysis of downstream consequences of fossil fuel development, one could argue, is consistent with requirements for other Federal agencies and departments. An honest and open public debate about our nation's energy policy should include public health concerns on an equal footing as security and economic considerations. In this instance, it would require the revision to the Draft EIS to calculate the population exposures to the air pollution generated from burning the fossil fuel extracted from Wyoming and Montana and to include the economic consequences of reduced life expectancy, increased medical cost and restricted activity days that result from air pollution.

Inclusion of New Local Power Plants:

The decision to exclude emissions from three coal fired power plants (Black Hill Power-WYGEN, North American Power's Mid-PRB, and Two Elks #2) was wrong. The particles released directly or formed downwind by reactions involving nitrogen oxide and sulfur dioxide will impact visibility and acid deposition as well as increase air pollution exposures to populations both within and outside the limited domain defined in the draft EIS. On page 5 of the Argonne Report Alternative 2a and 2b describe the use of electricity to power all or ½ of the compressors. They fail to say where or how the electricity will be generated. Presumably, the electricity will come from one of the nearby coal-fired power plants. Including the displaced emissions from generating electrical power to run the compressors seems reasonable. Table 7-1 shows the air quality impacts for alternatives 2a and 2b that are ½ to 1/3 of alternative

1. These estimates could be incorrect if the electrical power related emissions are not included.

Page 37 of the Argonne Report implies that this assessment is intended to provide a general idea of how much of the increments are consumed by a particular project and does not represent a regulatory PSD increment consumption analysis. Well, this raises the concern as to who is doing the comprehensive PSD analysis and whether it will include all the related development projects. It is inappropriate for the Draft EIS to make any conclusions with respect to PSD impacts until a comprehensive analysis is presented.

Inconsistent Alternatives:

The alternatives described in the Draft EIS are not substantially different except the "no build" case. For example, to claim, as the Draft ERIS does, that one of the alternatives will be to develop without regard for the environment is absurd and would not be permitted if existing laws were enforced. A more distinct set of choices should be offered. Partial development spread out over longer times together with evaluation studies offers options to introduce new technologies and or propose stricter guidelines. The Argonne Report describes a different set of alternative with respect to air quality assessment. Alternative 2 considers 1060 booster compressors that will be either all or ½ powered by electricity (pg. 6 of Argonne Report). Adding to the confusion the Draft EIS claims a "no build case" but the Argonne report has an Alternative 3 "no build" case that applies only to federal lands. This case would really allow more than 50% of the oil and gas wells to be developed on non-federal land, hardly a no-build situation. These inconsistencies might be serious flaws, misleading public, tribal leaders and decision makers. At the very least the air quality conclusions in the Draft EIS might be referring to a different set of bases cases and alternatives than actually assessed in the Argonne Report.

Reliance on Previous EIS Reports:

On page 1 of the Argonne Report there is a reference to "…several recent EIS for various development projects within the PRBO&G Project….". This raises two concerns. First, Argonne relied on decisions and analyses presented elsewhere making it difficult to near impossible to thoroughly review the current Argonne document. Second, the parsing out of the PRB Energy Development to several separate EIS's provides evidence that a comprehensive energy development plan has been made. Presenting EIS's for smaller fractionated projects prevent integrated environmental assessment and underrepresents the potential adverse and irrevocable damages.

Impacts Outside the Analysis Domain:

On page 9 of the Argonne Report it describes that the modeling domain for this assessment was taken from a previous EIS of the DM&E New Railway Retrofit Project. This is not sufficient justification. Railway impacts are not the same as wells, compressors, roads and power plants spread across a large geographic area. The fact is that formation of particles and deposition of acid aerosols will occur out side the domain selected.

Page 9 of the Argonne Report states that among its objectives was the assessment of "far-field impacts on critical air pollutants…". In fact, the analysis models emission on air quality standards, visibility and acid deposition. What is missing is the impact of air pollution on mortality and morbidity from the particles, SO_2 and NO_2 both within and beyond the domain. It has been demonstrated for many years now that secondary particles can form well beyond the 300 km range set for the Argonne assessment. Health damage functions for particle pollution can be applied to modeled population exposures to estimate mortality and morbidity for coal, oil and gas burning. Over the past decade, there have been tremendous advances in medical science and epidemiology that have allowed researchers to quantify the health impacts of everyday air pollution levels. In studies conducted in cities throughout the world, epidemiologists have consistently found that more people are hospitalized and die from respiratory and cardiac failure in proportion to elevated levels of soot, or "fine particle", and other pollutants. The consistent worldwide findings, combined with a much clearer understanding about how we are exposed to outdoor air pollution, have convinced most experts that these results are not a coincidence. In particular, two landmark studies established that people living in more polluted areas suffer a higher risk of death from fine particle pollution than those living in less polluted areas.1[1], 2[2]

These studies and many others formed the basis of U.S. EPA's 1997 decision to issue a new national ambient air quality standard for "fine particles" know as $PM_{2.5}$ and defined as particles smaller than 2.5 microns—one millionth of a meter in diameter (less than one-hundredth of the width of a human hair).3[3] EPA estimated that attaining the annual fine particle levels required by the new standard would prevent 15,000 deaths per year.4[4] And recent monitoring data suggests that if present air pollution levels persist, the health standards EPA established will be violated every year in hundreds of communities in the U.S. What is more, as EPA acknowledged, the science underlying the standards indicates that deaths occur even at levels below the standard. Indeed, the science now tells us that health effects extend to lower levels of fine particles in our air, suggesting there is no definite threshold below which the air is safe to breathe.

The Health Effects Institute (HEI), a research center co-funded by industry and EPA and founded to be a neutral arbiter for policy-related health science disputes, was called upon to reanalyze two important health studies. HEI's reanalysis unequivocally confirmed the findings of the two major studies underlying the fine particle standard. HEI also released a new study that further supports the link between particles and death.5[5], 6[6] There is no longer any legitimate doubt that fine particles at levels commonly experienced in many parts of the U.S. contribute significantly to death and disease.

Most of the coal used in this country today is burned by aging power plants for the production of electricity. In a variety of contexts, researchers have sought to quantify the contribution to particle health impacts made by these plants. Health researchers have employed some assessment methods to estimate the relative contribution of power plants to total death. EPA's Regulatory Impact Analysis for the $PM_{2.5}$ National Ambient Air Quality Standard (NAAQS) examined the contribution of power plant emissions to fine particle concentrations in our air.7[7] In addition, EPA's cost-benefit analyses of the Clean Air Act included the benefits associated with expected reductions in power plant-generated fine particle pollution, providing strong justification for the emission control costs imposed by the Act. More recently, in a study of two coal-fired power plants in Massachusetts, my Harvard School of Public Health colleague Jonathan Levy and I found that fine particle pollution form these two plants alone is associated with over 100 deaths annually.8[8]

These studies tell us that the concept of a threshold demarcating safe from unhealthy air is now outdated. They provide continuous damage functions that lead us to expect benefits from deeper and deeper reductions in air pollution. The insight derived from this new analytical approach provides important information to the benefit side of the cost-benefit debate. The debate over the policy consequences of this shift in thinking may be difficult and acrimonious in the near term as power companies, regulators, lawmakers, and citizens adjust to new concepts of incorporating health damage costs into control strategies, weigh local impacts versus regional damage, and consider the appropriateness of emission reduction trading among pollution sources. The primary advantage of a quantitative method to assess air pollution effects with no threshold is that it represents more accurately the biological reality. The old threshold concept appears even more outmoded when we consider the notion of "safe" levels for each of the hundreds of contaminants in the air. We will all benefit from this emerging methodology that brings air pollution health research into the public decision-making process. All of us, throughout our lives, are susceptible to the adverse effects of air pollution. Now our health interests can be more directly incorporated into the debate over our energy, environmental and economic future.

Uncertainties Not Presented:

The Argonne Report included no estimates of uncertainty. This is inadequate and incorrectly implies a level of certainty that defies physical reality. For example, a single year's meteorology was used, actual location of wells, construction sites, roads and compressors is not known or at least not modeled, emissions will vary, and there is uncertainty in the reactive chemistry of secondary particle formation to mention just a few of the sources of variability. It is not even clear if secondary particles were included in the $PM_{2.5}$ calculations. Conclusions drawn from this analysis is premature without a systematic treatment of uncertainty factors. Table 7-2 and Table 7-5 illustrate the importance of having confidence intervals associated with the estimated impacts. In these tables the near and far impacts for the different alternatives are presented. One can not conclude if these estimates are truly different. Further, it appears that the near field analysis for Alternative 3 (with only 50% of the total possible wells) will have larger impacts than for the full build case for some of the pollutants. All the air quality conclusions need to be expressed with a quantitative presentation of uncertainties bases on propagation of variability in parameters and meteorological processes.

We appreciated having an opportunity to work on this important energy development project, and hope that our assessment is taken seriously and incorporated into the final EIS.

Sincerely,

John D. Spengler

Akira Yamaguchi Professor of Environmental Health and Human Habitation Director,Environmental Science and Engineering Program

JDS/jca

Encl.

cc: Jerry Freilich, Wyoming Outdoor Council

Larry Sherwood, The Wilderness Society

Alan Eschenroeder, HSPH Adjunct Lecturer

Review Comments on the Powder River Basin Oil & Gas Development Project

Draft Environmental Impact Statement and the Preliminary Draft Technical Support Document on Air Quality Assessment for the Powder River Basin Oil and Gas Development Project

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1. INTRODUCTION

This document reviews and evaluates the air quality portion of the environmental impact statement (EIS) concerning the proposed extension of the coal bed methane and oil development in the Powder River Basin region of Montana and Wyoming. With respect to this objective, the emphasis is on the preliminary draft of the technical support document (TSD) entitled *Air Quality Impact Assessment for the Powder River Oil and Gas Development Project* dated January 2001. Lack of access to the next layer of background documentation limits the scope of the review to this report. We begin with general comments and continue with topical discussions of specific issues. These issue-oriented discussions cover the following subject areas:

- Determination of air pollutant emissions (Part **2**)
- Application of air quality models (Part **3**)
- Health effects of primary and secondary particulate matter (Part **4)**
- Impacts on visibility and acid deposition (Part **5**)
- Other impacts: climate , diesel and radon emissions (part **6**)

The overall presentation suggests that the air quality part of the study employed valid approaches to the technical problems throughout the documents delivered to our evaluation team. With an effort as complex as this EIS, several layers of background material serve to support the findings. Both the EIS and the TSD refer to background documents without specifically summarizing what each source contributed. Only a few sentences in the text after each citation would go a long way to orienting the reader as to the significance of the material derived from the reference under discussion.

The EIS seems to give air quality a short shrift compared with water issues. The remedy is to expand the discussions of air quality in the EIS. Such revisions will benefit from the participation of an experienced technical editor in order to improve the communications quality of the text. The authors should be mindful that the statutory purpose of the document is to transmit highly technical content to the affected public and to decision-makers. This is an area where careful word crafting should be incorporated into the next draft of the EIS and the TSD.

The National Environmental Policy Act9[9] of 1969 as amended mandates that every EIS must address a series of broad issues (Sec. 102 [42 USC § 4332]); namely, *"(i) the environmental impact of the proposed action,*

(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,

(iii) alternatives to the proposed action,

(iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented."

Under this broad charge, the issues of cumulative and secondary impacts arise for a project of such a magnitude as that proposed. There are areas in the case of the EIS reviewed here that are not addressed. Some of the broadly emergent questions treated in the detailed comments below are:

- What are the air quality impacts of the socioeconomic multiplier effects? (For example, additional population growth is stimulated by employment in the construction and operational phases of the project. They will generate vehicle traffic not considered in the EIS.)
- What impacts are avoided or introduced compared with a no action case? (If there were no further coal, oil or gas extracted.)
- What is the balance of environmental impacts on climate change (Will all of the CBM methane be reduced if coal mining follows the predicted course? - Will releases during exploration and well development be greater than the releases from future surface mining? - Does the conversion to carbon dioxide cause by burning the pipeline gas compensate for the fugitive emissions)
- What externalities are created by a significant augmentation (up to 3.6 billion cubic feet per day) of the national supply of natural gas? (Fuel substitution decisions made by the users of the produced gases at locations remote from the project site will affect air quality.)
- What trace contaminant impacts will there be with fugitive emissions from the exploration, development and production activities? (non-methane organic condensate species and radon in the produced gas and due to disturbed soils are not treated in the EIS.)
- Could material and energy balances be clarified? (For example, is there enough water to wet the unpaved roads as a mitigation measure? - - Do vehicle travel distances, trip generation and roadway lengths present a consistent picture?)
- What are the connections between air quality and health both for the public and the workers? (Population concentrations outside the project area may experience aggregate impacts from the propose development greater than those implied in the report.)

- Why does the EIS omit sudden accidental releases in its emissions inventory? (Well established risk analysis protocols have been available for decades in HAZOPS analysis of fault trees and consequence modeling in the process industry)
- Why does the EIS fail to apply available models describing the national energy supply and demand in order to investigate the impact of the proposed action on environments outside the study area? (For at least two years such models have been actively employed in the public domain; e.g., from the U.S. Department of Energy, Energy Information Center:*The National Energy Modeling System - An Overview - 2000* reported as DOE/EIA-0581(2000) at www.eia.doe.gov/oiaf/aeo/overview/pdf/0581(2000).pdf
- How do the proponents of the project justify limiting the analysis to the study area of a previous EIS for a railway extension project? (It has not been possible to find the rationale for limiting the air quality analysis to the same study area as a railroad "retrofit" project east of the development area)

The sections enumerated above present specific comments directed at these and other topics.

2. AIR POLLUTANT EMISSIONS

In this review, information relevant to emission factors used in the Preliminary Draft Technical Support Document Air Quality Impact Assessment for the Powder River Basin Oil and Gas Development Project (January 2001) are examined (hereafter referred to as "the Report"). The primary focus of the review was on Appendices A and B and on Section 4.1.1.1

Hours of operation needed to complete a "pad", amount of driving involved, hours of heavy equipment use and drilling rig emissions have not been evaluated. Relevant emission factors could be compared with documentation presented in EPA's AP-42 5th Edition Volume 1 and 2. Jan, 1995. The authors' choices of emission factors in the Report were compared with those recommended in EPA's AP-42 5th Edition.

In general, when the assumptions could be evaluated, the authors of the Report appear to have made reasonable or conservative assumptions. The modeling of the peak year appears to be a reasonable choice that is protective of human health from exposures to atmospheric emissions. It is protective because long-term emissions are overestimated. The pollutants examined in the Report are consistent (for the most part) with those reported in the EPA emission factors document. The emission factors appear to be consistent with reported values, when they could be verified. The types of emissions evaluated in the Report include: NO_x, SO_2, PM_{10}, $PM_{2.5}$, CO, VOCs and HAPs

Evaluation of the construction/installation, operation and/ maintenance of the following appears to be a reasonable estimate of emissions; however, accidental or transient releases such as valve failures, blowouts and well venting do not appear in the evaluation of emissions. The following sources were included: Wells, Well Pads, Compressors, Roads, Pipelines, Electric Power Lines and Other Ancillary Facilities

Some of the calculations performed in the document were checked when the information was available. In these cases, hand computation results were consistent with those reported.

Several specific concerns arose regarding the emissions reported in the Report. Lack of transparency is a key issue. Many of the emission factors are referenced to internal memos (as identified in detail below) that were not available for review. Inclusion of the memos or at least a more complete description of the logic used in them to generate the estimates is recommended and would increase the Report's transparency. A related transparency issue, the treatment of emissions associated with drilling activities needs to be clarified. As alluded to above, another area that should be explored from the emissions perspective are accidental releases through such events as drilling failures, pipeline failures, etc. This may include the types of pollutants that might be released, the anticipated frequency of these events, the magnitude of the events, their duration and their consequences. The Report authors should also explore the influences of variability and uncertainty on the air pollutant releases.

The comments on Appendix A follow the organization of the Report closely. Many of the same specific comments apply to sections of Appendix B. To avoid repetition, these are not restated but generalized.

Heavy Equipment/ Fugitive Dust (Report A.1.1)

The Report evaluates total suspended particulate (TSP) and particulate fractions comprising PM_{10} and $PM_{2.5}$. The value used in the Report, Emissions = 1.2 tons/acre/month of activity is consistent with the value recommended in EPA(1995). Spot checks of the internal calculations appear to verify those appearing in the Report.

EPA (1995) notes that "Only 1 set of field studies has been performed that attempts to relate the emissions from construction directly to an emission factor." The emission factor is based on field measurements of total suspended particulate (TSP) concentrations surrounding apartment and shopping center construction projects. "The value is most applicable to construction operations with: (1) medium activity level, (2) moderate silt contents, and (3) semiarid climate." The degree to which the project area reflects these types of applications should be described. Deviations from these should be noted and the impacts of these deviations on TSP described. EPA (1995) notes that the emission factor may be a conservative estimate. The fractions of TSP which comprise PM_{10} and $PM_{2.5}$ are based on memo from G. Muleski. The relevant assumptions can't be evaluated because we do not have a copy of the Muleski memo. We recommend reviewing the memo for accuracy of assumptions and relevance of data used to this site in Western US. Report authors may wish to attach the memo or discuss pertinent issues in the Report. Other assumptions appear to be consistent with those identified in the EPA document.

Emissions from Construction Activities

Data could not be evaluated because we do not have a copy of the Beels memos. Report authors may wish to attach the memos or discuss pertinent issues in the Report or the Appendix.

Exhaust emissions:

The selection of pollutants and data in the Report are consistent with values in EPA (1995). The pollutants evaluated are also consistent. The Report also fails to discuss the reliability of the emission factors

Emissions from industrial engines could not be evaluated. We do not have a copy of the Gomendi memo. Report authors may wish to attach the memo or discuss pertinent issues in the Report or Appendix.

Road Dust Emissions:

Aspects of this section were unclear. Emission Factors in the Report appear to be consistent with values in the EPA document for unpaved roads. The Equation parameters were developed from tests of traffic on unpaved surfaces; EPA notes that "a higher mean vehicle weight and a higher than normal traffic rate may be justified when performing a worst-case analysis of emissions from unpaved roads." However, the PM estimates from unpaved roads conducted here are likely to be an overestimate. EPA notes that "the quantity of dust emissions from a given segment of unpaved road varies linearly with the volume of traffic." Traffic volume estimates could not be evaluated based on the information available in the Report. It appears that a 50% reduction in road dust emissions due to water spraying was employed. This basis for this assumption should be described more thoroughly in the Appendix. No data were supplied by the Report on the quantity and availability of water and the emissions of vehicles require for this purpose.

Commuting Vehicles and Road Traffic (A.1.2)

PM and exhaust estimates appear to be consistent with those presented by EPA. Are there other pollutants of interest in this category? Thew basis of traffic volume generated seemed limited to project-related trips only. This omits recreational trips and additional vehicle movements generated by the growth in population induced by the proposed project.

Operational Activities:

Compressors A.2.1.

Exhaust emissions for PM_{10} and SO_2 appear to be consistent with EPA document. We do not have a copy of the Martinez memo. Report authors may wish to attach the memo or discuss pertinent issues in the Report. Note: Daily (2001) reference not cited.

Compressor emissions:

Could not be evaluated. We do not have a copy of the Keanini memos. Report authors may wish to attach the memos or discuss pertinent issues in the Report.

Dehydrators A2.2.

Exhaust estimates appear to be consistent with estimates in EPA document.

A.2.5. Well and Pipeline visits. And A.3.1. Road Maintenance

Emissions could not be evaluated. We do not have a copy of the Gomendi memo. Report authors may wish to attach the memo or discuss pertinent issues in the Report.

Reclamation Activities not reviewed because they do not occur during peak time.

Comments on Appendix B:

Comments on Appendix B are similar to those on Appendix A. There are a number of unavailable memos from which data are obtained. This information can not be evaluated because we do not have copies. When data from EPA's AP-42 are used, their use appears to be consistent with descriptions in EPA text. Several "conservative" choices in emissions factors appear to have been made by the Report authors. These appear to be overestimates of emissions in most cases.

Questions arise that are not addressed in the Report:

Are there Local Siting Criteria for wells/well pads? The document provides density of wells and other information. Within a given area where a well will be sited, do criteria exist (or can they be developed) that would minimize the local environmental or human health impacts from a well site?

3. APPLICATIONS OF AIR QUALITY MODELS

In this part of the review, information relevant to CALPUFF modeling used in the Preliminary Draft Technical Support Document Air Quality Impact Assessment for the Powder River Basin Oil and Gas Development Project (January 2001) was examined.

General Comments

This report used CALPUFF modeling system10[10] and selected the Interagency Workgroup on Air Quality Modeling (IWAQM)-recommended default settings when they are consistent with the current version of CALPUFF. Generally speaking, the projection system (Lambert Conformal Projection), background ozone, ammonia and nitric acid concentrations and the chemical transformation scheme (RIVAD/ARM3) used in the report are based on well-accepted air quality modeling practices and assumptions.

Specific Comments

This section discusses several issues in the report where either more information or addition modeling is needed.

1. The sources modeled are activities associated with the PRBO&G project that would result in emissions of air pollutants. These include construction/installation, operation, and/or maintenance of wells, well pads, compressors, roads, pipelines, electric power lines, and other ancillary facilities. However, the report did not provide information on how each source is specified. For example, are these sources modeled as point, line or volume source? If modeled as point source, what are the stack characteristics used, e.g. stack height, exit temperature and velocity?
2. The report did not provide information on how particle size distributions are specified for the PM10 and PM2.5 modeled. Different size distribution specifications can influence the deposition velocities of particles modeled.

3. The report mentioned that the RIVAD/ARM3 chemical transformation scheme11[11] was used to model the conversion from SO2 to sulfate and from NOx to nitrate. However, it is not clear how secondary sulfate and nitrate are reported.

   For example, on page 35 it has ‘Potential increases in concentrations of SO2, NO2, PM10, PM2.5 and sulfur and nitrogen deposition, as well as in visibility impairment, were predicted at selected receptor locations, as described in Section 4.’ Does this mean that sulfate and nitrate were combined with primary particles and the PM2.5 and PM10 reported include both primary and secondary particles?

   Other work using CALPUFF report primary and secondary particles separately, so that it is possible to separate the impact of them. For example, in their Illinois study, Levy et al. estimated the population-weighted annual average concentration increments associated with its current emissions to be 0.05 $\mu g/m^3$ of primary

PM2.5, 0.13 □g/m^3 of secondary sulfate particles and 0.10 □g/m^3 of secondary nitrate (Levy et al., 2002)12[12].

4. The modeling domain includes northeastern Wyoming and portions of adjacent Montana, South Dakota, and Nebraska. There are "134 by 94 grid cells (5-km by 5-km) in the modeling domain", which covers an area of 670 by 470 km.

   Fine particles can travel long distance in the atmosphere while the modeling domain defined above may not capture the full impact of the sources under concern. The following graph shows how the intake fraction (defined as the fraction of material released from a source that is eventually inhaled or ingested by a population) of different pollutants change with distance for a power plant modeled in China (Zhou, 2002)13[13]. It shows that it takes at least 600 km for the fine particles modeled to reach half of its overall intake fraction.

   The implication of this result is important in this case, although the stack characteristics, meteorology and population patterns under study are different. The areas where fine particles and their precursors are generated in Wyoming are not heavily populated. However, fine particles have the potential to travel to other more densely populated areas (outside the modeling domain) and may result in significant human health impacts, which are not modeled in the report.

5. **HEALTH EFFECTS OF PRIMARY AND SECONDARY**

   PARTICULATE MATTER

General Comments

- The PRB should investigate human health impacts that might arise from the air quality effects (specifically, from fine particles).
- The PRB-EIS should consider what would happen to the coal or methane gas once it is extracted. When burned, these fuels will add further to health effects from air pollution further away from the project location.
- Differential health effects from air pollution should be investigated. Some groups are more affected by air pollution than others are, and these sensitive sub-populations should be considered.

Specific Comments

The PRB-EIS fails to adequately address the problem of health effects associated from fine particulate matter. Fine particulate matter, or $PM_{2.5}$, encompasses particles smaller than 2.5 micrometers. Fine particles may be either generated at the source of combustion activities (called primary particulate matter) or from chemical reactions involving sulfur and nitrogen oxides generated by combustion that react to form atmospheric aerosols (called secondary particulate matter). Both will contribute to serious human health effects, even at everyday air pollution levels, because PM is so small that it can penetrate deep into the alveolar regions of the lungs.14[14]

Air pollution levels have been linked in medical and epidemiological studies to increased hospitalizations and deaths from respiratory and cardiac failures. Two landmark studies established that people living in more polluted areas suffered a higher risk of death from fine particle air pollution than those living in less polluted areas. The first, referred to as the *Harvard Six-Cities Study* was published in 1993.15[15] It tracked over 8,000 people living in six U.S. cities over seventeen years. After controlling for other factors such as smoking, body mass, occupation, etc., they found the risk of death in highly polluted areas was 26% higher than in areas with the lowest pollution levels. However, an even more critical finding was that there is a linear increase in risk proportional to increased particle concentrations. This finding implies that there is *no* zero risk level for fine particle inhalation exposure of humans.

Two years later, the *American Cancer Society Study* was published.16[16] This study traced over a half million adults in 151 different metropolitan areas for more than seven years. Detailed information was collected about each study participant, and included age, sex, weight, height, demographic characteristics, smoking history, alcohol use, occupational exposures and other factors. This study found a 17% increase in mortality risk in areas with higher concentrations of fine particles. It has been estimated that about 4% of the death rate in the U.S. can be attributed to air pollution. This corresponds to about 60,000 deaths per year.17[17]

Although the evidence that fine particles caused serious morbidity and mortality effects in the U.S. now seemed obvious, polluting industries disputed the validity of this research when the EPA acted to improve this problem in 1997 by issuing new air quality standards for fine particles. The researchers agreed to a third-party reanalysis by the Health Effects Institute, a non-profit organization jointly funded by the EPA and industry to be an unbiased reviewer. The HEI reanalysis confirmed the results of both studies and additionally found that lower educated individuals might be more susceptible to the deleterious effects of air pollution.18[18] Therefore, the concept of a PM threshold demarcating safe exposures is outdated. Continuous damage functions should be used to evaluate benefits from pollution reductions, and similarly costs due to increased pollution sources.

The PRB-EIS only considers the air quality effects associated with extracting coal and methane from the ground, while it is the combustion of these fuels that will have significant air quality and health impacts. Most of the coal in the U.S. is burned in aging, or "grandfathered", coal-fired power plants. These plants do not have to conform to the strict emission guidelines that new power plants must adhere to and subsequently, emit large amounts of fine particles and sulfates. A recent study found that only two coal-fired power plants in Massachusetts were responsible for over 100 deaths annually.19[19] Health effects from the use of the coal and methane should be investigated by the PRB-EIS.

The PRB-EIS should investigate the effect of increased air pollution on susceptible subpopulations. There is growing evidence that people in lower socio-economic groups are affected by air pollution to a greater extent than those of higher socio-economic status. Additionally, in response to air pollution, it has been found that lower-income people are at greater risk of all-cause mortality and diabetics are at greater risk of cardiovascular hospital admissions.20[20]

Epidemiological studies performed over the past 40 years have shown that the prevalence of diagnosed diabetes has increased dramatically in the U.S. and that a substantial proportion of the population has undiagnosed diabetes. Diabetes is most prevalent in minority populations, including Native Americans. Increasing prevalence of diabetes has led to increases in microvascular complications such as blindness, end-stage renal disease, and lower limb amputations.21[21] A number of studies compared the insulin sensitivity of various national and ethnic populations within the U.S. to the total U.S. population and were analyzed to find possible risk factors for the development of type 2 diabetes. It was found that the risks for diabetes in African-Americans, Hispanics, and Native Americans are approximately 2, 2.5, and 5 times greater, respectively, than in Caucasians. There is an inverse relationship between socioeconomic status and the prevalence of diabetes. It also appears that while cultural effects may lead to an increased incidence of obesity in these populations, (and may lead to insulin resistance), genetic factors may also contribute.22[22]

Some unanswered questions:

How to address the fact that if the power plants are not getting the gas from PRB, will get it elsewhere or will use coal fuel?

Population densities within and outside the designated project area vary widely - - How will subsequent drafts of the EIS address this?

Does the model produce secondary aerosol concentrations by size range?

6. IMPACTS ON VISIBILITY AND ACID DEPOSITION

OVERALL COMMENTS

The report fails to consider the alternative process of flue gas injection to enhance coal bed methane production and to sequester carbon dioxide. A cartoon explanation of this process is found at the web address:

http://www.arc.ab.ca/envir/Coalbed_animation.asp

VISIBILITY:

General:

Visibility impacts were assessed by using procedures drafted by the Federal Land Managers' Air Quality Related Values Workgroup (FLAG). The EIS technical background document assumes a natural background reference level and visibility parameter equations.

FLAG developed their analysis of visibility impairment using pollutants: Fine PM, ammonium nitrate, secondary ammonium sulfate. Are there other pollutants that can impair visibility that should be included in the concentrations to calculate the predicted percent change? What about hydrocarbons forming organically-based aerosols? Other secondary pollutants?

The report uses daily values for visibility and acid deposition estimates. It seems that visibility would matter more during the daylight hours. Would meteorological factors contribute to a day vs. night visibility issue? There is a diurnal cycle with light scattering, and neither the modeling results or the visibility analysis seems capable of tracking hourly variations of the causative factors.

A metric of haze embodies a proportionality to the logarithm of the atmospheric extinction (b_{ext}). one of the drawbacks with Deciview is that its output is not easily related to gaseous and aerosol concentrations.

Interagency Monitoring of Protected Visual Environments (IMPROVE) network is a three phased effort to monitor visibility trends in Class I areas. The IMPROVE program was initiated in 1985. This program implemented an extensive long term monitoring program to establish the current visibility conditions, track changes in visibility and determine causal mechanism for the visibility impairment in the National Parks and Wilderness Areas. The IMPROVE program produces trend data on visibility; however, the EIS support document fails to make use of these data.

The objectives of IMPROVE are:

(1) to establish current visibility and aerosol conditions in mandatory class I areas;

(2) to identify chemical species and emission sources responsible for existing man-made visibility impairment;

(3) to document long-term trends for assessing progress towards the national visibility goal;

(4) and with the enactment of the Regional Haze Rule, to provided regional haze monitoring representing all visibility-protected federal class I areas where practical.

IMPROVE Steering Committee consists of people from the following organizations: NOAA, CSU, Forest Service, Fish and Wildlife Service, BLM, Northeast States for Coordinated Air Use Management (NESCAUM), EPA, Western States Air Resources Council , State of Arizona, State and Territorial Air Pollution Program Administrators

Website: http://vista.cira.colostate.edu/improve/Default.htm

The report fails to state why VISCREEN software was not used to calculate visibility impacts. It should have included visual effects of plumes from present and future coal-fired power plants in the area.

Specific:

Devil's Tower is not listed in Table 4-7 and it appears to be the closest area of concern to the project. Furthermore, Table 4-7 only lists Class I areas but they mention they review visibility impairment in certain Class II regions as well.

In the summary of effects (Table S-2) it lists a change of > dv .5 for up to 44 days. A change of > 1dv up to 12 days. Why do they mention the .5 dv change in this table if they later only talk about 1 dv change is the threshold. (Don Shepherd's notes mention that the NPS considers exceedance of 0.5 dv to be a potentially adverse effect. The last 4 points in his memo deal with visibility)

A question arises about the last paragraph on page 32 (argonne) which states that WY DEQ also calculated reference levels. It was not mentioned in the EIS. They are all higher than the FLAG reference levels except for one. A change in dv calculated with the WY DEQ baseline will be lower than that using the FLAG reference levels.

Table 4-14: There are regions that exceed a1.0 dv change (One that goes up to 10 days) They do not mention how much greater than 1.0 dv. This would seem important to assess the impact. The change in dv details are listed in Appendix F of Argonne Report and should be addressed in the EIS instead of listing > 1dv change.

Acid Deposition:

General:

Acid deposition impacts were assessed by comparing annual total acid deposition fluxes to sensitive lakes in terms of their acid neutralization capacity (ANC). They used wet, dry and total deposition fluxes of total sulfur and nitrogen.

Are there other lakes besides the 8 listed that should be analyzed? Are there any lakes to the north or east that should be studied?

<100 μeq/L is defined as Sensitive

<25 μeq/L is defined as Extremely Sensitive

The 8 lakes listed range of ANC from 32-68 μeq/L. The percent change is all under 10% for Alt. 1 and the other Alternatives.

<25 μeq/L: no more than 1 μeq/L allowed

>25 μeq/L: no more than 10% change allowed

The nearest lake is the most sensitive. Should this be more of a concern? According to the map, it appears to be on the border of the Project Area and in the table it says it's 91 km from it. Where is the distance being measured from?

No mention is made of the *National Acid Deposition Program* data output. The National Atmospheric Deposition Program (NADP) network consists of about 200 sites throughout the United States which continuously monitor precipitation chemistry. There is a monitoring station in Weston County, Wyoming.

Members are from State Agricultural Experiment Stations, USGS, U.S. Department of Agriculture, and other agencies. See http://nadp.sws.uiuc.edu/

Specific:

Appendix H (Argonne Report): Only lists annual deposition rate of Sulfur and Nitrogen. Are there other pollutants that can effect sensitive lakes?

On p. 40 of Argonne report it says “estimates were made by following the procedure developed by the FS Rocky Mountain Region (2000).” The reader needs more detail than the report supplies.

p.3-58 lists table of sensitive lakes. It does not include Upper Frozen Lake located in the Bridger Wilderness Area. However, it is listed on p.34 of Argonne report but data are not available .

Percent ANC change was not calculated for Upper Frozen Lake because ANC data were not available.

p.4-109 says “No sensitive lakes were identified by either the NPS or USFWS although the first sentence says that they found lakes within wilderness areas that were sensitive in the first sentence. This is misleading or confusing. Are there any sensitive lakes outside of NPS and USFWS.

6. OTHER IMPACTS: CLIMATE, DIESEL AND RADON EMISSIONS

Transportation

- It is unclear how the transportation calculations were performed. Specifically, how did the modelers estimate additional number of roadways to be created, and the number of project-related vehicle miles per year? Has any consideration been give to non-project related use of these roadways, once created, for recreational, residential and other uses? Has resultant residential or commercial development on these or nearby lands been considered?
- Our additional transportation-related concerns include noise abatement in both residential and industrial (occupational) areas, the environmental impact of occasional upkeep of new roadways, and possible infringement upon nearby restoration areas both through increased travel through the area and air emissions into these Class I areas.
- It appears as if all service roads in the development area will remain unpaved. As such, we are skeptical about the planned use of watering techniques to control dust. Questions that arise include whether there are adequate water supplies in the area to water all such roads, the effect of evaporation and the short-term nature of this solution, the high maintenance effort that would go into this watering effort, the additional diesel emissions that will be created from the watering trucks, and the additional cost of this effort.

Generating capacity

- The estimates of generation capacity and duration of use for ancillary generators seem broad, and the average NOx emissions rate of 1.5 g/hp-hr (4-295) during operation seems overly simplisitic. How will use of these generators differ during various phases of the project? Do emissions rates vary during start-up and shut-down, or will they be running at varying capacities?
- What is the net energy gain from this development, considering the large amount of generation- and transportation-related fuel that will be burned in the extraction process?23[23] Emissions rates should be calculated with *net* energy potential as the denominator, not raw energy potential extracted from the mines.
- Likewise, we found the number of wells to be drilled is not internally consistent in some parts of the report. Because there is great uncertainty about the actual extent of development to take place, we find it even more tenuous to estimates the attributable amount of energy demanded in the extraction, and the attributable number of roadways and vehicular trips.
- Where are the potential leaks in this process? What is the expected greenhouse gas (GHG) equivalent of the estimated methane leakage? Which of the underlying coal beds will be mined? If there were mining without methane being extracted, there would be a greater GHG impact without the project than with it. These balances of emissions must be evaluated in future drafts of the EIS. The draft EIS states that expected climate change effects were analyzed and no significant adverse impacts are anticipated, but the calculation of this GHG potential is not made clear (EIS, 4-101).

Other issues

- There are many instances in the EIS where reference is made to source-specific air quality permitting requirements for each new ancillary facility in the area, in lieu of specific analyses of the expected number of such facilities and respective emissions (for example, EIS 4-106. This piece-meal approach inappropriate to the planning of such a large-scale effort that will have a significant cumulative environmental impact. This is particularly true as the anticipated density of new facilities in this area, each requiring individual permits, is extremely high: 458 sources requiring WDEQ-AQD permits, 34 requiring MTDEQ-AWM permits, 13 requiring multi-state permits (4-108).
- The environmental and economic impacts of commuting are not accounted for in the report. Because the project is expected to create a large number of new jobs in the area, we believe that this impact needs be addressed.
- Exposure to radon and other radionuclides are not addressed at all within the report. The Gas Research Institute and others in the fields are increasing putting efforts into monitoring the concentration of radon in natural gas streams and in residential homes.24[24] Because the U.S. Geological Survey has identified most

of the states of Wyoming and Montana as of high geological radon potential,25[25] it is crucial both for the safety of workers in the area and for gas consumers that these risks be carefully considered before moving forward on this development. Radon radiation induces radioactivity in mechanical parts near the wellhead (such as compressor blades). The worker safety issues raised by these phenomena should be evaluated on the basis of available data from the field.

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34[9] (Pub. L. 91-190, 42 U.S.C. 4321-4347, January 1, 1970, as amended by Pub. L. 94-52, July 3, 1975, Pub. L. 94-83, August 9, 1975, and Pub. L. 97-258, § 4(b), Sept. 13, 1982)

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37[12] Levy JI, Spengler JD, Hlinka D, Sullivan D, Moon D: Using CALPUFF to evaluate the impacts of power plant emissions in Illinois: Model sensitivity and implications. *Atmospheric Environment* 2002; 36(6):1063-1075.

38[13] Zhou Y: Evaluation of human health damage from power plant emissions in China. Doctoral thesis, Harvard School of Public Health, 2002.

39[14] Death, Disease & Dirty Power, Mortality and Health Damage Due to Air Pollution from Power Plants. Clean Air Task Force, Boston, 2000 (Available online at http://www.cleantheair.org)

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48[23] The EIS cites that 0.5 MW would be used per day to transport 3 bcf of natural gas using gas-fired compression. What is the emissions equivalent of this demand?

49[24] http://wwwgriweb.gastechnology.org/pub/abstracts/9092.html

50[25] http://www.intas.be/catalog/93-3001.htm