From: "Stern, Paul"
To: Edward Hanlon/DC/USEPA/US@EPA
Date: 02/28/2011 09:42 AM
Subject: RE: EPA Science Advisory Board Hydraulic Fracturing Research Plan Panel

Dear Mr. Hanlon,

I am sorry to be slow in responding to your note below. I have been out on vacation for the past 2 weeks.

Please feel free to share my letter to you as a public comment for the meeting next week. On the basis of a quick look at the draft study plan, I decided ideally, my letter should be amended to address the study plan, which includes items that go beyond the plan for the technical workshops, which my letter addresses. However, I doubt that I will have the needed time this week. So please use the letter I sent you, adding a note to the effect that it was sent before the draft study plan was available for public comment.

Thank you for sharing my comment with the other participants in the process. I look forward to the SAB's responses to the comments.

Sincerely,

Paul Stern

To: Edward Hanlon/DC/USEPA/US@EPA
Date: 01/24/2011 09:33 AM
Subject: RE: EPA Science Advisory Board Hydraulic Fracturing Research Plan Panel

Dear Ed Hanlon,

Attached is a letter addressed to you that is intended for those involved in developing and reviewing the study plan for the hydraulic fracturing study. It is a revision of an informal message I sent to Jill Dean last month. I hope you can bring these concerns to the attention of the review panel for the study plan and, if possible, also to those developing the study plan, at or before the planned public meeting on March 7-8.

I would also appreciate being informed of the plans and agenda for the public meeting.

Thank you for your attention to these issues.

Sincerely,

Paul C. Stern

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Dear Ed Hanlon,

I am writing to raise a set of issues that I think will be important to consider in the hydrological fracturing study if it is to achieve the highest levels of scientific credibility and public legitimacy. I ask that you bring these concerns to the attention of the review panel for the study plan before or at the planned public meeting on March 7-8.

The hydrological fracturing study will be important to the development of this emerging technology and to the nation's energy future. It is important that the risk analysis be both scientifically credible and responsive to the needs, concerns, and interests of those who will bear the risks. The costs to the nation of a study that fails to be both credible and legitimate could be quite large. Based on my inferences from what I have seen so far, particularly the plans for the technical workshops over the next two months, I see significant threats to the credibility and legitimacy of the study.

The issues scheduled to be addressed in the technical workshops are important. However, if this list represents the full scope of the scientific and technical evidence base for the hydrological fracturing study, the study will get—and will deserve—serious criticism. It will have neglected to address many legitimate water risk issues of concern to the people facing the risks the study is supposed to examine. As the National Research Council pointed out in its 1996 report, *Understanding Risk*, risk analyses need to begin by getting "the right science", that is, science that addresses the risk questions of concern

and importance to the range of interested and affected parties. Based on my limited contact with interested and affected parties in the Marcellus shale region, this list of technical issues falls considerably short in addressing their questions.

Below, I offer two lists of scientific and technical topics that are not apparent on the one-pager describing the topics for the workshops, but that I think are essential to a complete and credible study of the relationship between hydraulic fracturing and drinking water. My list is only illustrative. The best way to get the right list of technical questions for a broadly credible study is to gather them from a range of interested and affected parties. An excellent strategy would be to implement the recommendation of the SAB's Environmental Engineering Committee for "developing a balanced, collaborative advisory group of stakeholders representing a broad range of perspectives, and engaging with this stakeholder group throughout the research process." Such a group could point the study toward scientific questions of recognized importance among the interested and affected parties. Comments at the recent town meetings might be another source of such questions. I offer substantive suggestions at the end of this letter for what might still be done to get a sufficiently broad knowledge base for a credible and legitimate study.

Industry life cycle. The list of workshop topics appears to overlook some key parts of the life cycle of gas recovery by hydrological fracturing, all of which could affect drinking water:

- Production of hydraulic fracturing chemicals
- Effects of water withdrawals on water supplies and quality
- Transportation of the fracturing chemicals to regional distribution centers
- Transfer of chemicals at distribution centers and well sites
- Transportation of hydraulic fracturing liquids to well sites and of waste liquids and extracted soils to disposal sites
- Adequacy of infrastructure and its maintenance for transportation of chemicals (e.g., rural road systems)
- Adequacy of local water treatment plants for treating recovered liquids
- Management of soils and soil contaminants at water treatment and waste disposal sites
- Consequences of the effects on water, and of concerns about the effects on water, for public health, livability of rural communities, property values, and community cohesion/disruption
- Legacy issues (e.g., the appearance of hydraulic fracturing chemicals in water supplies decades after gas extraction has ceased) and the capability to anticipate, identify, and mitigate such hazards.

Several of these issues are already matters of concern in the Marcellus shale region, where there is the prospect of chemical spills from trucks on icy, poorly maintained rural roads; minimal regulation of operations at chemical storage and transfer locations; illegal dumping of chemical waste residues from trucks; and illegal disposal of contaminated soils in town landfills—much of this on top of aquifers or near major river systems or

lakes. Technical analyses should consider the effects of the entire life cycle of this industry on water resources, and not only the effects of activities at well sites.

Risk management systems. The list also appears to overlook technical issues about risk management systems, which can have considerable influence over the actual risks to water. For example:

- The ability of federal, state, and local government agencies to monitor chemical spills, especially during transport and at widely dispersed well sites, and to sanction responsible parties
- Adequacy of monitoring protocols for identifying and measuring chemical releases
- The ability to detect and monitor releases of chemical brine through cracked well casings into groundwater sources
- The ability to determine the sources of fracturing chemicals that may be found in drinking water and, if hydraulic fracturing activities are responsible, to identify the responsible parties and hold them accountable
- The ability of the legal, regulatory, and insurance systems to provide sufficient incentives for the industry to police itself with regard to releases of toxics into drinking water sources throughout the life cycle
- The ability of enforcement authorities to prevent (and if that fails, to detect and punish) illegal disposal of liquids and solids contaminated with toxic substances from the hydraulic fracturing life cycle
- The ability of insurance and liability systems to provide adequate and timely compensation to households or communities who are affected in a negative way.

Analysis of the adequacy of risk management systems is not always a part of risk assessments, which are often narrowly focused on the physical and chemical processes that affect risks. However, such analysis is critical for the hydrological fracturing study because risk management systems will influence the degree to which best practices are followed, and therefore, the level of actual risk. Even measurement capabilities (e.g., the ability to detect chemical releases and attribute them to the activities that caused them) will affect risk because actors will be more careful if they know that their emissions can be traced back to them. In this particular industry, risk management is very challenging. There are a variety of actors, some of them small, dispersed, and hard to regulate (e.g., trucking companies). Moreover, the regulators and the suppliers of safety and monitoring infrastructure (e.g., safe roads, waste disposal sites) are a patchwork of federal, state, and local agencies, some of which are poorly funded and understaffed, many of which are poorly coordinated, and some of which may be beholden to industry.

The above list includes several issues that are already matters of concern in the Marcellus shale region. For example, some people whose water wells have been found to contain toxic chemicals used in hydrological fracturing have been told by industry officials that these chemicals might have been there before the fracturing began. There is strong mistrust of such messages from an industry that had long refused to make public a list of the chemicals that are being used, thus making it virtually impossible for people to

demonstrate the absence of those chemicals before gas exploration began. Can monitoring be better than this? Is a systematic program of baseline testing feasible (the costs would probably be miniscule compared to the costs of drilling or of litigation and compensation)? Are techniques available to attribute contamination to its sources after the fact? Is it feasible for individuals and local governments to use them (e.g., on household water wells)? Is it technically feasible to add chemical markers to fracturing liquids before use to make emissions traceable? What can be done, if anything, to restore contaminated water wells for subsequent use? If full restoration is not possible, what are the effects of water contamination on health, well-being, and property values? What systems can be devised to compensate the losers?

There is a considerable knowledge base in the social sciences regarding risk management systems for addressing the problem of maintaining the quality of "common-pool resources", including drinking water supplies. Some of this work resulted in the awarding of the Nobel Memorial Prize in economics to Elinor Ostrom a few years ago. This knowledge can be used to identify weaknesses in risk management systems that increase risks to water resources. It has also produced a set of design principles that can be applied to managing such risks. The hydraulic fracturing study will be more responsive to the public's needs to the extent that it includes analysis of the relevant risk management systems as well as of chemical and hydrological processes.

Asking the right questions will be critical to the credibility of the planned study. Even though much groundwork has already been laid for the study, EPA might still be able to do things to ensure that the full range of water risk issues is addressed in the study and that the study pays attention to the water-related concerns of people who are facing the risks.

First, it could (if it has not already done so) adopt the recommendation of the SAB's Environmental Engineering Committee to establish an advisory group of stakeholders early in the process. At the early stages, such a group can help define the questions that the study must answer to be responsive to stakeholders' concerns. EPA could also identify such concerns by examining the transcripts of EPA's regional meetings to identify key scientific questions about the risks to water that were raised by members of the public in the shale deposit areas. Where these questions relate to the topics of the scheduled workshops, EPA could present them to the invited experts, noting that they have come from participants in public meetings, and could engage the experts in trying to answer them. This may broaden the list of technical questions that they address, and it will have the added value of demonstrating that EPA's study is responsive to public concerns. Where the questions do not map onto workshop agendas, more would have to be done (see below). But without explicit attention to expressed public concerns, there is the strong possibility that the study will be widely rejected as inadequate, regardless of how strenuous its efforts may be to get the science right on chemical measurement, fate and transport, etc.

Second, EPA could consider organizing an additional workshop to address questions that are critical to the water study, including questions raised in the public meetings, which will not be covered in the workshops already being planned. The above lists suggest

questions in two categories: industry life cycle; and risk management, mitigation, and compensation issues. A look through the public comments might suggest a different and better organization.

Considering scientific questions raised by members of the public in the hydrological fracturing study would not only lead to a more comprehensive and legitimate study, but it would also show a good faith effort to implement President Obama's January 21, 2009 Executive Order on participatory government. It is possible for risk assessments to incorporate the input of non-experts without compromising scientific quality, and addressing questions from the public in a scientifically responsible way is one good way to do this.

I would also like to express concern about the fact that, despite the request in the Federal Register notice for nominations for the review panel of people with expertise in "social, behavioral, and decision sciences", the review panel does not appear to include any such expertise. This gap increases my level of concern that the study may not give adequate attention to key risk issues, for example, by analyzing the effects of risk management systems on the behavior of the many actors in the industry, and thereby on the overall risks to water.

I offer these comments because I hope they can help EPA produce an analysis of this important issue that meets the highest standards of scientific quality while also being responsive to the full range of legitimate concerns about the risks. Please let me know if there is a formal mechanism that I should be using to submit these comments. I would be glad to respond to further questions from you, from the study plan review panel, or from those involved in conducting the study.

Sincerely,

Paul C. Stern
National Research Council (affiliation listed for identification purposes only; these comments are my own and are not official comments from the Council)