MPUC Docket No. E-6472-/M-05-1993
OAH Docket No. 12-2500-17260-2

BEFORE THE
MINNESOTA OFFICE OF ADMINISTRATIVE HEARINGS
100 Washington Square, Suite 1700
Minneapolis, Minnesota 55401-2138

FOR THE
MINNESOTA PUBLIC UTILITIES COMMISSION
127 7th Place East, Suite 350
St. Paul, Minnesota 55101-2147

In the Matter of the Petition of Excelsior Energy Inc. and Its Wholly-Owned Subsidiary MEP-I, LLC For Approval of Terms and Conditions For The Sale of Power From Its Innovative Energy Project Using Clean Energy Technology Under Minn. Stat. § 216B.1694 and a Determination That the Clean Energy Technology Is Or Is Likely To Be a Least-Cost Alternative Under Minn. Stat. § 216B.1693

SUPPLEMENTAL TESTIMONY AND EXHIBITS OF EXCELSIOR ENERGY INC.

Daniel P. Schrag

June 19, 2006

EXCELSIOR ENERGY, INC.

BEFORE THE MINNESOTA PUBLIC UTILITIES COMMISSION

PREPARED SUPPLEMENTAL TESTIMONY OF

DANIEL P. SCHRAG

Q Please state your name, current employment position and business address.

A Daniel P. Schrag. I am Professor of Earth and Planetary Sciences and Environmental Engineering in the Department of Earth and Planetary Sciences and the Division of Engineering and Applied Sciences at Harvard University in Cambridge Massachusetts. My business address is 20 Oxford Street, Cambridge, MA 02138. My curriculum vitae is attached as Exhibit DPS-1 to this testimony.

Q Would you please describe your educational and professional background?

A I received my bachelors degree from Yale University in Geology & Geophysics and Political Science. I received my Ph.D. in Geology from the University of California at Berkeley. I was an Assistant Professor at Princeton University from 1993 through 1997, and then an Associate Professor and Professor at Harvard University from 1997 through the present. I am a geochemist with expertise in climate and climate change, the carbon cycle, energy technology, and carbon sequestration. I have authored or co-authored over 70 scientific papers, have been honored with numerous awards including a MacArthur Fellowship in 2000. I receive my research funding from federal agencies including the National Science Foundation and the Department of Energy. I am Director of the Harvard University Center for the Environment, a university-wide program to integrate research and education across the many parts of Harvard including the Business School, the Law School, the Kennedy School, the School of Public Health, the Graduate School of Design, the Medical School, as well as Arts and Sciences. In that capacity, I am leading the Harvard University Energy Initiative, which brings perspectives from all these different disciplines and others together to address questions about energy use, environmental consequences, national security, and economic development.

I have never worked with Excelsior Energy Inc. ("Excelsior"), and had never heard of the Mesaba Energy Project until I was contacted by officers of Excelsior a few weeks ago, who were interested in my perspective on carbon sequestration and advanced coal technologies.

Q On whose behalf are you testifying?

A I am testifying on behalf of Excelsior Energy Inc.

Scope and Summary

Q What is the scope of your testimony in this proceeding?

A The primary purpose of my testimony is to describe how advanced coal technologies such as Integrated Gasification Combined Cycle (IGCC) are important for mitigation of future climate change through the potential to capture carbon dioxide emissions and store them in geologic repositories. I am also testifying as an expert on climate change and climate change policy and on the likelihood that strict carbon regulations that require carbon capture and sequestration will be imposed during the lifetime of any coal-fired generating plant built today.

Q Can you please briefly describe the global use of fossil fuels for energy production?

A Yes. Energy is an essential element of modern society, with almost all economic activity intimately linked to its supply and utilization. The world obtains more than 80 percent of its energy from the combustion of fossil fuels including more than 85 million barrels of oil each day. The growth in oil demand over the next few decades, driven by rapidly developing countries, could overwhelm world oil production. Demand for natural gas is also increasing faster than new discoveries, creating greater dependence on the hydrocarbon-rich regions of the world including Russia and the Middle East. Concerns about energy security have played a central role in geopolitical conflicts for more than a century, and the potential for future conflicts increasingly animates international tensions. Consequently, other sources of fossil fuels, especially coal and unconventional sources of oil such as tar sands, will begin to play a larger role. But the continued use of fossil fuel as the major source of world energy has ominous implications for future harmful impacts on the environment.

Q: What are some of those implications?

A: Current global consumption of fossil fuel releases almost 30 billion tons of carbon dioxide into the atmosphere each year. If current trends continue, and coal becomes even more important as a source of energy for the world, then atmospheric carbon dioxide will triple by the end of the century, bringing the Earth to an atmospheric composition not seen for more than 40 million years. Given the long lifetime of energy infrastructure, it is difficult to design even the most aggressive mitigation strategy to keep CO_2 from doubling, especially with large deposits of inexpensive coal in those countries that consume the most energy. There is no debate that the rise in atmospheric CO_2 is warming the planet, nor that climate will continue to change over the next century. What remains uncertain is exactly how much the climate will change, what the impacts will be, how much they will cost, how these impacts might be avoided, and how much it will cost to avoid them. And climate is not the only way that fossil fuel consumption can affect societies and natural ecosystems. Various forms of water and air pollution from energy conversion and consumption are major concerns for human health and the natural environment across the developing and developed world.

Q: What are some of the reported observations of climate change?

A: Over the last decade, signs of climate change have become more and more pronounced. The Arctic ice cap has thinned by more than 40%. Ice is melting from all of the tall mountain glaciers in the tropics. And recent studies have shown that the power dissipation by tropical cyclones (hurricanes) is strongly correlated with sea surface temperature, which will continue to rise with carbon dioxide concentrations.

Q: Do you believe the Unites States will adopt some form of CO_2 regulation in the coming decade?

A: Yes. Faced with all of these observations of a changing climate, as well as the risk of rapid and catastrophic change, such as the collapse of the Greenland Ice Sheet, which would raise sea level by more than 20 feet, many governments have taken steps to reduce carbon emissions. The United States has been slower than other developed countries in these steps for a variety of reasons too numerous to discuss here. The important point is that it is extremely likely that the United States will join the effort to reduce carbon dioxide emissions sometime over the next decade, perhaps even sooner. Several of the potential presidential candidates for the 2008 election from both parties have spoken out strongly for action on climate change, and there are several different bills being prepared in the Senate that appear to have increasing support. Exactly what will trigger the change in policy is difficult to predict; it could be a change in administration in the White House, a series of natural disasters that create a public cry for action, or simply a gradual shift in congressional leadership. But whatever the trigger, the change will affect all Americans through a change in the way energy prices are calculated. We will be forced to pay for the true cost of fossil fuel, which includes its environmental consequences.

Q: What has been the response of the private sector to these observations of climate change?

A: Many companies have recognized that regulations that restrict the emission of carbon dioxide are a part of the future, and that steps can be taken today to minimize the impact of those regulations on future business practices. Investments in energy efficiency through advanced technologies, better building design, and other strategies are more and more common. But from the perspective of electricity generation, the choices are much more challenging.

Q: Is it possible to develop an electricity generation strategy for the United States that does not use fossil fuels, and in particular coal?

A: No. The problem is that renewable energies in general are much more expensive than fossil fuels, and most forms of renewable energy cannot be expanded rapidly, nor are they appropriate for replacing coal or gas power plants and still meeting our ever-growing energy demand. For example, the sun does not shine 24 hours per day, and current ways of storing electricity are inadequate. Moreover, the cost of electricity from photovoltaics is approximately four times as high as from coal combustion. Over time, better technologies may emerge and costs of renewables may decline, but for the foreseeable future, there is no substitute for fossil fuels, and coal in particular. *Coal is an essential source of energy for the US over the next 50 years. One cannot create an energy plan for the US without relying heavily on coal.*

Q: How we can use coal to generate electricity without releasing carbon dioxide and other harmful pollutants into the air?

A: We must capture the carbon dioxide and store it in various geologic repositories, which include deep saline aquifers in sedimentary basins, and marine sediments hundreds of meters below the ocean floor. There is a large research effort in the US on geologic storage of carbon dioxide, and many different strategies have been proposed. What is clear is that, although there are still some technical issues that must be solved that are specific to individual sites of carbon storage, the capacity to store tens of billions of tons of carbon dioxide per year does exist and is technically feasible.

Q: What are the approaches to the capture of carbon emissions from power plants?

A: How to capture carbon dioxide from the power plant itself is a more difficult engineering question. A super-critical, pulverized coal plant burns coal in air, producing a waste stream that is roughly 80% nitrogen and 20% carbon dioxide. Separating the carbon dioxide from the nitrogen is costly. Thus, the current stock of coal-fired power plants, that were not designed with carbon capture in mind may preclude carbon sequestration, or at least make it very expensive. An alternative approach is to build new forms of coal power plants that produce a concentrated effluent of carbon dioxide that is much easier to capture and store. The most common technology is IGCC, which has been built in a handful of locations around the world. The IGCC technology has several advantages. The efficiency of the generation is often higher than super critical plants, reducing the amount of CO_2 emitted per unit of electricity produced. Non-CO2 pollution is generally much lower (e.g., mercury), depending on the specific design of the plant, a fact that by itself creates significant public interest benefits in favor of IGCC as compared to super critical plants. But most importantly, the IGCC plants can be retrofitted to include a “shift reaction” that essentially produces a concentrated effluent of carbon dioxide at relatively high pressures, all ready for piping to a geologic repository for storage. The capture of carbon in this case is not free, but is far less expensive than capture using a traditional pulverized coal design. The downside of the IGCC technology is that it is often slightly more expensive up front, although I understand from Excelsior Energy that certain federal incentives available to its Mesaba Project under the federal Energy Policy Act of 2005 have significantly reduced the cost disparity one might expect between IGCC and traditional pulverized coal technologies. However, as I will discuss below, even without any federal incentives, the potential benefits of IGCC far outweigh the modest premium in capital cost.

Q: What are the potential benefits of IGCC technology?

A: It provides an unparalleled technological hedge (compared to super critical technologies) in the face of almost certain carbon regulations that will be put in place during the lifetime of any new power plant. No one knows exactly when carbon regulations will be put in place, or what those regulations will say. Some companies have decided to invest in traditional, pulverized coal plants because they are less expensive to build, and then to work towards making sure that the carbon regulations will be long in arriving. However, this may also mean that these plants will have to shut down if action on climate change occurs more quickly than anticipated. The investment in IGCC technology may be more expensive, but IGCC will provide a more stable price for electricity in the future as the cost of reducing carbon emissions, when carbon regulation does occur, will be much more manageable.

Q: Should the companies that build IGCC plants be forced to put in the carbon capture technology today to make them truly "capture ready"?

A: I think the answer to this is no. Such an investment does not make sense in advance of actual regulations controlling carbon dioxide emissions. The consumers would simply pay a higher price for electricity without any real benefit. Moreover, the Department of Energy is still working with various partners to develop the optimal capture technology for an IGCC plant, so waiting may result in better and cheaper designs. When the political will exists to regulate carbon at the level that carbon sequestration is economical, then fitting an IGCC plant with appropriate devices to capture the carbon should be relatively straightforward.

Q: Why is it in the public interest to support IGCC projects like the Mesaba Project now?

A: I often discuss issues of climate change and energy technology with financial groups including large investment banks. I believe they are becoming more and more convinced that their portfolios that include major energy projects must consider questions of future climate change and carbon regulation when making investment decisions as the time scale for some of these investments is several decades and they are being exposed to serious risks that they have not previously considered. The perspective of a State like Minnesota is somewhat different from an investment bank, but there are some similarities. The people of Minnesota are the ones who ultimately pay for the costs of bad investments in energy infrastructure through higher prices for electricity. Through the 80s and 90s, natural gas plants were built all over the US because gas was proclaimed to be abundant and cheap. But we have learned that these pronouncements were mistaken, and many of these power plants now sit idle as the natural gas is too expensive to use in this way. The current situation with coal plants in this country is similar. Investment decisions are being made today for plants that will be used for the next 50 years or more. Investments that do not account for a future world with restrictions in carbon emissions are taking a huge risk that, like the natural gas plants, the technologies will not be flexible enough to accommodate new regulations and new prices. In my view it is absolutely imperative if we are to have any chance of controlling the increases in CO_2 emissions in the coming decades (much less achieving actual decreases in CO_2 emissions) that the new fleet of coal-fueled power plants across the country utilize IGCC technology instead of traditional pulverized coal technologies.

Q Does this conclude your prepared supplemental testimony?

A Yes.

EXHIBITS

EXHIBIT NO. ____ (DPS-1)

Resume

CURRICULUM VITAE

DANIEL P. SCHRAG

Date of Birth: January 25, 1966

Education:

B.S. 1988, Yale University (Geology & Geophysics and Political Science)
Ph.D. 1993, University of California at Berkeley (Geology)

Ph.D. Dissertation Supervisors:
Donald J. DePaolo (U.C. Berkeley)
Frank M. Richter (Univ. of Chicago)

Post-Doctoral Supervisor:
John M. Hayes (Indiana Univ.)

Honors:

James B. Macelwane Medal, American Geophysical Union (2001)
MacArthur Fellow (2000)
Technology Review TR100 – 100 young innovators for the next century (1999)
Ocean Drilling Program Fellowship (Berkeley) (1992)
Samuel Lewis Penfield Prize in Mineralogy (Yale) (1988)
Katherine K. Walker Prize in Political Science (Yale) (1988)
Frank M. Patterson Prize in Political Science (Yale) (1987)
Westinghouse Science Talent Search Finalist (1984)

Professional Experience:

Professor, Dept. of Earth and Planetary Sciences, Harvard University	2000-
Associate Professor, Dept. of Earth and Planetary Sciences, Harvard University	1997-2000
Assistant Professor, Dept. of Geosciences, Princeton University	1994 -1997
Visiting Researcher, Indiana University	1993
Geologist, Newmont Mining	1988

Memberships:
American Geophysical Union; Geochemical Society; American Meteorological Society; American Academy for the Advancement of Science; Canadian Institute for Advanced Research.

Service:
Professional: Board of Reviewing Editors, *Science* (2002 - 2005); Associate Editor, *Geochem., Geophys., Geosyst.* (1999 -); Advisory Committee for Earth Institute of Columbia University (2002 -).

University: University Center for the Environment (Director); Center for Geographic Analysis (Steering Committee); Committee on Oceanography; Board of Tutors for Environmental Science and Public Policy; Committee on Collections for Earth and Planetary Sciences; Faculty Advisory Committee on Affiliated Housing.

Research Interests:
Application of geochemistry to problems concerning the geologic record of climate change, history of the oceans and atmosphere, and interactions between the environment and life.

Publications

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